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# 096 Beaufort Sea Artificial Island Erosion Data

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Environmental Studies Revolving Funds

Report No. 096

# BEAUFORT SEA ARTIFICIAL ISLAND EROSION DATA

by

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## SUMMARY

This report presents the results of a field survey to obtain erosion data on an artificial island in the Beaufort Sea. The survey was conducted on Itiyok Island in the summer of 1986.

The first survey, conducted in mid-August, employed beach profile and echo sounding techniques to successfully obtain three-dimensional data (x,y,z coordinates) of the island morphology. Short term (daily) cliff erosion was also measured in response to wind and waves from the northeast. An average of 3.4 m of erosion occurred along the exposed side of the island over a two day period.

In late August, a succession of storms occurred. During this period the island was severly eroded to the extent that the exposed portion of the island was transformed into a shallow (approx. 2 m deep) shoal. The second survey attempt, employing a modified positioning and survey approach, was conducted in September. However, unfavourable weather conditions over the survey period prevented any data being collected.

Data from the first survey is presented in the form of tables, profiles, contour plots and three-dimensional perspective plots. All of the collected data is contained in two diskettes. In addition, bathymetric data from a previous survey conducted in 1984 is compared to the results of this survey. Uncertainties in the relative position of the 1984 and 1986 survey origins make it unlikely that reliable estimates of profile change due to sediment transport can be derived.

## RESUME

Le présent rapport énonce les résultats d'une étude du terrain destinée à obtenir des données sur l'érosion d'une île artificielle située dans la mer de Beaufort. L'étude a été menée sur l'île Itiyok pendant l'été de 1986.

Pour la première étude réalisée à la mi-août, on a eu recours à des techniques de détermination du profil de la plage et à des techniques de sondage acoustique afin d'obtenir des données tri-dimensionnelles (coordonnées x, y, z) sur la morphologie de l'île. On a également mesuré l'érosion de la falaise à court terme (quotidienne) causée par le vent et les vagues du nord-est. La moyenne d'érosion pour les deux jours était de 3.4 m le long du côté exposé de l'île.

A la fin d'août, les tempêtes se sont succédé. Au cours de cette période, l'île a subi une érosion considérable, au point où la partie exposée de l'île a été transformée en un haut-fond peu profond (environ 2 m). En septembre, on a tenté d'effectuer la seconde étude en utilisant une méthode modifiée de positionnement et de contrôle. Cependant, devant les mauvaises conditions météorologiques, aucune donnée n'a pu être recueillie.

Les résultats de la première étude sont présentés sous forme de tableaux, de profils, de tracés de contour et de tracés en perspective tri-dimensionnelle. Les données ont été introduites sur deux disquettes. En outre, les données bathymétriques recueillies au cours d'une étude menée en 1984 sont comparées aux résultats de la présente étude. Comme la position relative des études de 1984 et de 1986 n'est pas connue, ilest peu probable que des estimations fiables des changements de profils causés par le déplacement des sédiments puissent être déterminées.

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# 1.0 INTRODUCTION

This report presents the results of a field survey conducted to measure the erosion of an artificial sand island in the Beaufort Sea. The purpose of the study was to obtain and document field data on rates of erosion of circular artificial islands or berms. The requirement for the study was identified by the Bottom Sediment Transport Study Committee of ESRF. The objective of the study was defined as follows:

> "to obtain field data on the erosion of sand and gravel islands in the Beaufort Sea in order that numerical models of erosion processes can be calibrated" (ESRF, 1985).

Previously, the stability of artificial sand island designs had been investigated mainly with scale model results or simple, linear, beach-profile mathematical models. In the future, when more permanent artificial islands may be considered for production facilities, improved mathematical models will be required which will need verification by both scale model tests and full scale island erosion studies (Hodgins et al., 1986).

The artificial sand island known as Itiyok I-27 was suggested by ESRF as a possible candidate from a number of abandoned artificial islands and submerged caisson berms. Itiyok was chosen because of its suitable median sediment size, relative lack of debris and the fact that it was relativley intact and above water to maximize the potential erosion volume. In addition, historical survey data existed.

The field study was initially scheduled for the summer of 1985. However, persistent ice cover in the area of Itiyok during the summer of 1985 did not provide suitable conditions for either island erosion by waves or survey operations by boat. The study was therefore re-scheduled for the summer of 1986.

The first field survey was completed during the second week of August, 1986. In the next two weeks extensive open water conditions combined with minor and major storm events caused waves to erode the island to such an extent that it became submerged in late August, 1986. Taking this into consideration and after consultation with the Scientific Authority, the second field survey was attempted in the second week of September, 1986. The site of the island was reached by boat but persistent high wind and wave conditions during this period prevented a second survey from being conducted. The scheduling of a third survey attempt was considered but budget constraints and the high likelihood of persistently stormy conditions in late September prevented a third survey attempt.

The successful first field survey has provided data of sufficient precision and quantity to allow the production of a detailed contour map of island morphology, both above and below the waterline. The data on eroding cliff position collected during the first survey has also provided estimtates of short term erosion rates associated with moderate wave events. In addition, data from a previous survey (Canadian Engineering Surveys, 1984) was compared to the results of this survey.

# 2.0 DESCRIPTION OF THE STUDY SITE

## 2.1 Itiyok Island History and Morphology

The study site, Itiyok I-27 artificial island, is located in the southern Beaufort Sea at 69° 56' 40" N. Lat. and 134° 05' 19" W. Long. The site is approximately 75 km northwest of Tuktoyaktuk (Figure 2.1). Itiyok Island was constructed in water depths of 14 to 15 m below mean sea level according to the Canadian Hydrographic Service Chart 7604. Island construction was completed in the fall of 1982. Drilling began in November, 1982 and was terminated in May, 1983. A significant gas and oil discovery was made (COGLA, 1983 Annual Report).

Erosion of the sacrificial beach island proceeded through the open water seasons of 1983 and 1984. A bathymetric survey of Itiyok was conducted on August 17, 1984 (Canadian Engineering Surveys, 1984). The bottom diameter of island at 13 m water depth was approximately 400 to 500 m. Since the survey was conducted by a relatively large vessel, the ATL ARCTIC NANABUSH, the draft prevented close approach to the shore and the shallowest depth surveyed was 5 m below mean sea level. According to the CES drawing no data is shown above this depth. The design diameter for the top of the island was 150 m. The working surface was approximately 4 - 5 m above sea level.

A vertical air photo taken in February, 1985 shows the effects of some erosion (Figure 2.2). The greatest diameter of the island is approximately 95 m. Wing bars are present on the northwest and southwest corners of the island. Ice ridges form a ring around the island at a distance of from 140 to 260 m from the centre. Based upon depths shown on the CES bathymetric drawing, the ice ridge position corresponds to a depth range of 5-7 m. Very little change in island morphology is thought to have taken place in the summer of 1985 due to the absence of wave attack because of persistent ice cover.

The island as seen in August, 1986 is shown in Figure 2.3. The general dimensions and morphology of the island were only slightly changed from that shown in the air photo (Figure 2.2)

## 2.2 Oceanographic and Environmental Conditions

Relevant oceanographic and atmospheric parameters affecting the study site during the open water season include tides, waves, currents, wind, fog, and cold air and water temperatures. The tide range at the nearest reference station at Tuktoyaktuk is 0.5 m. This range decreases offshore to approximately 0.3 m at Itiyok.

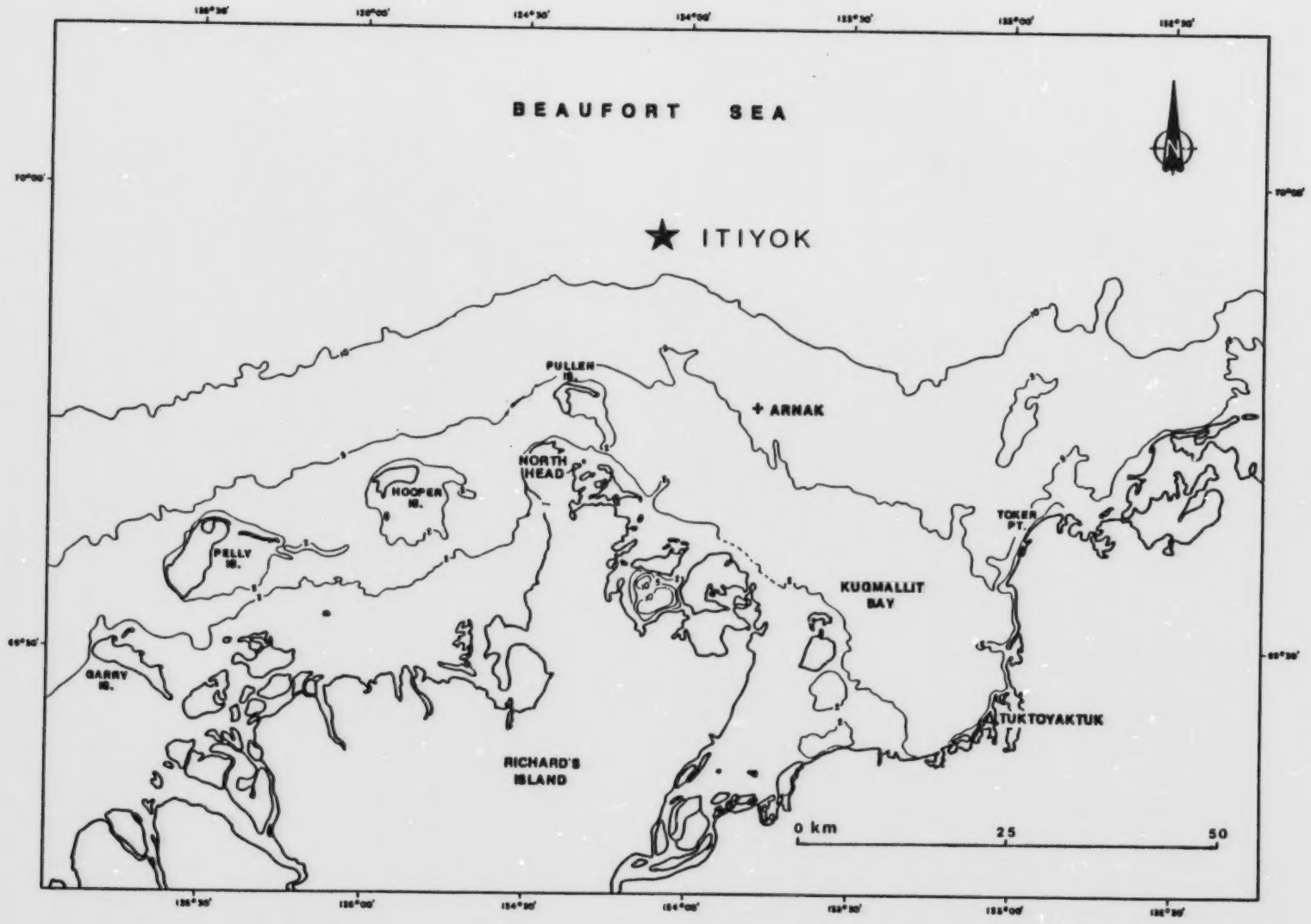



Figure 2.1 Location of Itiyok I-27 artificial island.

Figure 2.2 Airphoto of Itiyok taken in February, 1985.
Approximate scale: 1 cm = 35 m.

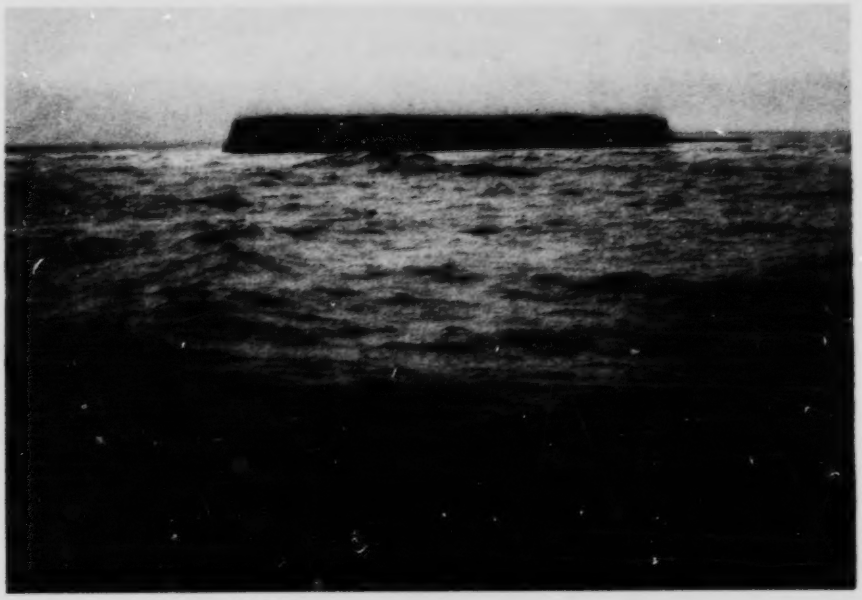


Figure 2.3 Itiyok viewed from the northwest on August 11, 1986. The photo shows the actively eroding cliff on the northeast (left) side and beach and bar accumulation on the west side. The maximum length of the island is approximately 90 m. The flat top surface has an elevation of 4 to 4.5 m above sea level.

In addition, storm surges may produce extreme water levels of + 2.3 m to - 0.8 m at Tuktoyaktuk (Canadian Hydrographic Service, 1986). Storm surge levels at Itiyok are not known precisely. Wind and wave conditions at the site over the study period (mid-August to mid-September) affected survey operations on most days. A summary of forecast and visually observed wind and wave conditions during the two survey periods is included in Appendix 1 and Appendix 2. Winds in excess of 15 knots and seas in excess of 1 m significant wave height caused noticeable erosion of the island and prevented survey boat operations close to shore. In this respect, surf zone widths on the windward side of the island were in the order to 50 to 100 m during periods when wave heights were 1 m.

Fog also affected operations significantly during the mid-August survey. At times, visibility was less than 100 m . In addition, light fog conditions also prevented operation of the electronic distance measuring instrument. Cold air and sea temperatures (down to 1-2°C) were common.

No ice was observed in the vicinity of Itiyok during the two survey periods. According to ice charts summarized in Hodgins et al. (1986), at the start of the study (mid-August) open water conditions extended offshore approximately 125, 75 and 125 km respectively, to the northwest, north and northeast. During the second survey (mid-September), open water conditions extended further offshore to 175, 125 and 300 km respectively, to the northwest, north and northeast.

## 2.3 Field Site Logistics

The initial field survey was primarily conducted using the IMPERIAL IMMERK as a means of getting to Itiyok Island from either Tuktoyaktuk or Arnak Island which was operational at the time. At Itiyok, the IMPERIAL IMMERK would not approach closer than 200 m from the island. This was due to the risk of the vessel's propellor becoming fouled by the loose, black-fibre sandbag debris on the bottom at shallow depths around the island. The shallow bars around the island also posed a potential hazard. Therefore, it was necessary to transfer all survey equipment to a 14 foot aluminum boat to reach the island.

There were many weather delays because of fog, high winds and rough seas during the first survey period (see Appendix 1 for details). In addition, further delays were caused during potentially suitable surveying weather when the IMPERIAL IMMERK was being used for other Esso offshore operational requirements.

The second field survey attempt was conducted using the HERSCHEL, on charter from Beaufort Environmental Support Services. The HERSCHEL was substantially larger than the IMMERK, had

accomodations on board for the skipper and survey party, and was under sole charter to this contract so that no conflicts of use existed. During the second survey, the HERSCHEL was able to lay at anchor at Pullen Island for three days waiting on the weather to improve. Pullen Island was only one hour from Itiyok, whereas the one-way time from Tuktoyaktuk to Itiyok was five to six hours. However, continuously bad weather during the September survey period prevented any surveying activities taking place.

# 3.0 FIELD TECHNIQUES AND INSTRUMENTATION

According to the Statement of Work (E.S.R.F., 1985), the survey was designed to satisfy the following criteria:

(1) The relative vertical precision must be at least ± 15 cm.

(2) There must be enough data points horizontally to establish the location and size of morphological features. A continuous survey technique would be preferred. The survey should be conducted on radial lines at 10 degrees of arc spacing, established such that the second survey will be done within 1 m of the first at each radial at the waterline.

(3) The survey equipment must be capable of surveying from the -6 m contour, inshore to the shoreline.

(4) The above-water portion of the island must be surveyed along the same radials to the precision of the offshore survey.

## 3.1 Design of the Data Collection Program

The surveying of the island involved establishing a centrally located bench mark to provide a relative, local, vertical and horizontal reference control point. Next, radial survey lines at 10 degree arc spacing were established by installing a set of 36 range poles at 10 m from the central bench mark. A Brunton compass was used to determine the direction of profile line 000 at true north. The range poles were intended to provide a reference for both the land-based and bathymetric surveys. In addition, they would also have provided for the second survey to have been conducted along the same lines as the first survey.

## 3.2 August, 1986 Survey

The central benchmark and range poles were installed as described above (see Figure 3.1). Standard level, tape and stadia rod survey methods were used to survey the exposed portion of the island from the centrally located bench mark (Figure 3.2). The beach survey was extended to wading depths permitted by wave action, currents and safety. For this purpose, the rod man wore an insulated dry suit. Generally, the sub-tidal portion of the beach was surveyed to depths of 0.5 to 1.0 m below sea level.

Figure 3.1 Island surface showing benchmark pattern for circular survey grid. (August 8, 1986).

Figure 3.2 Surveying island surface with tape and rod along line 000 as viewed due north. Waves are breaking on the wing bar on the northwest corner of the island. (August 10, 1986).

Elevation measurement resolution was to 0.01 m. Distance measurement resulution was to 0.1 m using a fiberglass tape measure and to 1 m using the stadia rod sightings at distances greater than 50 m from the central bench mark.

An attempt was also made to measure short term (daily) erosional changes in the position of the cliff edge of the island. Surveys of the distance from the central bench mark to the cliff edge were conducted on three days. An example of the extent and form of erosion is shown in Figures 3.3, 3.4, 3.5 and 3.6. The results of the cliff erosion survey are presented and discussed in section 5.1.

Conventional echo sounding techniques were used to survey the submerged portion of the island. This involved the use of the following:

(1) a shallow draft, 14 foot aluminum boat
(2) a survey echo sounder
(3) an electronic distance measuring (EDM) instrument
(4) range poles and portable radios for position control.

Operationally, the survey boat would steer toward the island along a survey line bearing (000, 090, 180 etc.) as defined by the range poles. Distances along the survey line were normally read at 20 m intervals from the EDM and radioed to the echo sounder operator to be entered as fix marks on the sounder recordings.

Distance along the survey line is determined by siting the EDM onto a reflector prism mounted on a pole above the echo sounder transducer. The EDM provides a continuous, digital display.

A Raytheon DE-719B survey quality echo sounder was used to obtain a continuous record of seabed depths along the survey lines. The sounder uses a narrow transducer beam with an operating frequency of 208 KHz. Sounder depth accuracy is +/- 0.5%, or better than +/- 0.05 m in depths less than 10 m. Standard hydrographic procedures were followed in the field. Specifically, "bar checks" were conducted at the beginning and end of each survey day in order to properly calibrate the sounder operation to local water column characteristics.

Prior to conducting the bathymetric survey by echo sounder, a water level gauge was installed on the beach on the southwest side of the island (see Figure 3.7). The water level, relative to the central bench mark elevation, was determined at regular intervals during the echo sounder survey.

Sediment grab samples were also collected around the island (Table 3.1). Unfortunately, these were subsequently lost and no size analyses are available.

Figure 3.3 Eroding cliff on Profile Line 020. The cliff is approximately 4 m high. (August 12, 1986).

Figure 3.4 Large diameter pipe buried near surface at Profile Line 160, as viewed to the north. (August 10, 1986).

Figure 3.5 Pipe eroded out of cliff at Profile Line 160 two days later. (August 12, 1986).

Figure 3.6 Undercutting of cliff base at waterline by thermo-erosion. The soil is frozen above the undercut. The undercut extends 1 to 1.5 m into the cliff base. (August 13, 1986).

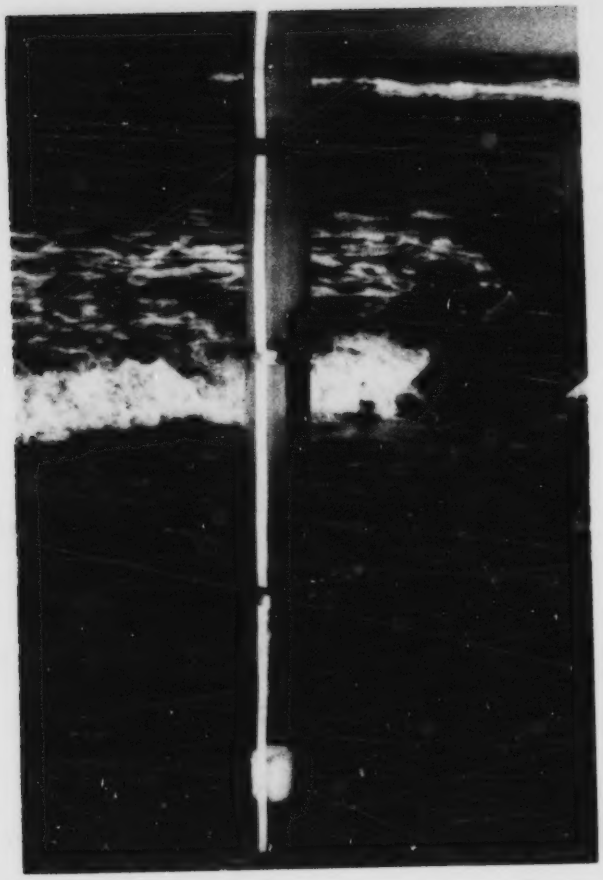


Figure 3.7 Water level gauge installed on southwest side of island. The mean water level is marked by the base of the white float. (August 10, 1986).

Table 3.1 Collected sediment samples.

| Date | Sediment Sample # | Description |
|---|---|---|
| August 12 | 1 | Line 270, water line |
| | 2 | Line 00, water line |
| | 3 | Line 90, water line |
| | 4 | Line 180, water line |
| August 13 | 5 | Line 00, water line |
| | 6 | Line 45, water line |
| | 7 | Line 90, water line |
| | 8 | Line 135, water line |
| | 9 | Line 180, water line |
| | 10 | Line 225, water line |
| | 11 | Line 270, water line |
| | 12 | Line 315, water line |

Notes: (1) All samples were medium sand.
(2) Clay and clay balls were abundant. Clay (up to 1 m thickness) was present at the cliff base from line 00 to 90.

## 3.3 September, 1986 Survey

Since the exposed portion of the island had disappeared below sea level in late August, the techniques used in the first survey were no longer applicable. An alternate technique, using the Syledis positioning system was proposed. The Syledis system would have provided positioning accuracy of +/- 10 to 20 m related to an absolute position. It was thus proposed to survey the island by heading the survey vessel, the HERSCHEL, toward the island on a series of radial lines while collecting a continuous echo sounding record. In order to reach relatively shallow depths (shallower than 3 m), the use of this method would have required wave heights less than 1 m.

During the second survey attempt Itiyok was reached on September 14, 1986. The location was marked by an area of waves breaking over the submerged shoal remnant of the former island (see Figure 3.8). Visual observations of breaking wave heights at the location suggested that the submerged shoal was approximately 2 m below sea level.

High winds and rough seas prevented any surveying that day. The survey boat anchored near Pullen Island for three days, but weather conditions did not improve (see Appendix 2 for details). Over the September survey period, weather conditions did not permit any surveying activities to take place.

Figure 3.8 Submerged remnant of Itiyok on September 14, 1986. The island has been reduced to a shallow (approx. 2 m deep) shoal awash with breaking waves.

# 4.0 DATA REDUCTION PROCEDURES

## 4.1 Beach Profile Data

Each beach profile, comprising distance and elevation data, was entered onto a computer file. All distances were referenced to 0.0 m at the central bench mark. All elevations were adjusted to a common reference elevation of 0.0 m representing mean sea level.

The beach profile data set consists of 36 radial profiles at 10 degree arc intervals. A total of 422 distance/elevation data pairs were collected to define the morphology of the island to a depth of about 0.5 to 1 m below mean sea level.

## 4.2 Bathymetric Profile Data

A total of 21 bathymetric profiles were available for data reduction. A log of the echo sounding lines conducted and the 21 lines reduced to provide bathymetric data is contained in Table 4.1. The echo sounding records that were used are also presented in Appendix 3. Because of weather and time constraints in the field, the radial spacing is at 20 degree arc intervals instead of the desired 10 degree interval.

Each echo sounder recording was digitized at a 10 m distance interval to a depth resolution of 0.1 m. This data was then entered onto a computer file and all depths were adjusted to the commom reference elevation of 0.0 m representing mean sea level. The depth adjustments were derived from the water level gauge measurements. Most lines did not require any correction since they were surveyed at a water level within 0.1 m of mean sea level. The maximum correction required was 0.1 m.

The bathymetric profile data set consists of a total of 493 distance/depth data pairs. The shallowest depths surveyed were generally 2-3 m. Therefore, there is normally a 1-2 m depth gap of data between the deepest portion of the beach profile and the shallowest portion of the echo sounder profile.

## 4.3 Conversion to X, Y, Z Coordinates

The original data as entered into the computer was in the form of line number (bearing), distance and elevation or depth. This data is tabulated in Appendix 5 and is written on Data Diskette 1 as described in Appendix 7. This data was subsequently converted into a three-dimensional format in order to allow for the production of contour and perspective plots. The 3-D data is written on Data Diskette 2 as described in Appendix 7.

Table 4.1 Echo sounder survey line log.

| Date: | Aug. 10 | Aug. 12 | Aug. 13 | Aug. 13 |
|---|---|---|---|---|
| Positioning: | EDM | Transit | Transit | EDM |
| Line # | | | | |
| 00 | | | 00* | |
| 10 | | | | |
| 20 | | | 20 | 20A* |
| 30 | | | | |
| 40 | | | 40 | 40A* |
| 50 | | | | |
| 60 | | | | 60* |
| 70 | | | | |
| 80 | | | | 80* |
| 90 | | | | |
| 100 | | | | 100* |
| 110 | | | | |
| 120 | | | | 120* |
| 130 | | | | |
| 140 | | | 140 | 140A* |
| 150 | | | | |
| 160 | | | 160,160A | 160B* |
| 170 | | | | |
| 180 | | | 180 | 180A* |
| 190 | | | | |
| 200 | | | 200* | |
| 210 | | | | |
| 220 | | | 220* | |
| 230 | | | | |
| 240 | | | 240* | |
| 250 | 250,250A* | | | |
| 260 | 260* | | | |
| 270 | 270* | | | |
| 280 | 280* | | | |
| 290 | 290* | | | |
| 300 | 300* | 300A | 300B | |
| 310 | | | | |
| 320 | | 320 | 320A* | |
| 330 | | | | |
| 340 | | | 340* | |
| 350 | | | | |

Note: Surveyed lines marked with (*) were reduced to compile the bathymetric data set.

## 4.4 Canadian Engineering Surveys 1984 Data

A bathymetric survey of Itiyok Island had been conducted previously in August, 1984 (CES, 1984). Using the bathymetric drawing of that survey, distance and depth data was extracted and entered onto a diskette to allow comparison with the data obtained from the 1986 survey conducted in this study.

The CES 1984 data exists as depth values on radial profile lines at a 20 degree arc interval. The data extends over the depth range between 5 m and 15 m below sea level and over the distance range between 150 m and 400 m from the "design island centre" as defined on the drawing. In this respect, distances measured on the drawing of the CES 1984 data will not be the same as those measured in the 1986 survey. This is because distances in the 1986 survey data set were measured relative to the benchmark installed at that time and the location of the 1986 benchmark relative to the "design island centre" location is not known. Therefore, the coordinates of the origins for the two surveys are very probably not the same, and could differ by 20 to 30 m from each other.

The CES 1984 data is tabulated in Appendix 6 and is written on Data Diskette 1 as described in Appendix 7.

# 5.0 RESULTS OF FIELD SURVEYS

## 5.1 Short Term Cliff Erosion

From the data on eroding cliff position presented in Table 5.1, it has been possible to compute the mean erosion change for the period August 10 to 13 between survey lines 010 to 140. This area of the island represents the cliff section which was actively eroding under the attack of waves from the northeast to east. A plot of the measured total erosional changes is presented in Figure 5.1.

The mean erosion change between profile lines 010 and 140 was determined to be -3.4 m. Most of this change took place on August 11. Conditions over the period August 10 to 13 were variable but generally comprised northeast to east winds of 10-20 knots and waves of 0.5 to 2.0 m (Appendix 2).

## 5.2 August, 1986 Survey

Photocopies of the echo sounding records used to derive the 1986 survey data set are presented in Appendix 3.

The beach data and combined beach and bathymetric data sets were written onto a IBM-PC compatible 5.25" diskette. The format and contents of the data on diskette are described in Appendix 7.

The data from the 1986 survey is tabulated in Appendix 5. The tables are comprised of both beach and bathymetric survey data in the form of distance and elevation data pairs along each profile line.

Plots of all surveyed profiles are contained in Appendix 4. All of the surveyed profiles contain beach data while 21 of the 36 profiles also contain additional bathymetric data. In addition, where CES 1984 data is available at an interval of 20 degrees of arc, it has also been plotted for comparative purposes.

Contour plots of the beach data and the combined beach and bathymetric data are presented, respectively, in Figures 5.2 and 5.3. Regarding the contour plot in Figure 5.3, the results of the 1986 survey are very similar in general appearance to the CES 1984 contour plot.

Three-dimensional perspective plots of the beach data and the combined beach and bathymetric data are presented, respectively, in Figures 5.4 and 5.5. In both plots the view is from the southwest.

Table 5.1 Distance to cliff edge (m) and total erosion (m).

| Line # | Distance (m), to Cliff Edge 21:00 Aug. 8 | 13:00 Aug. 10 | 18:00 Aug. 12 | 14:00 Aug. 13 | Total Erosion |
|---|---|---|---|---|---|
| 00 | > 40 | 43.4 | 43.4 | 43.5 | + 0.1 |
| 10 | > 40 | 45.0 | 41.9 | 40.7 | - 4.3 |
| 20 | > 40 | 38.9 | 37.0 | 37.1 | - 1.8 |
| 30 | > 35 | 34.5 | 32.1 | 31.4 | - 3.1 |
| 40 | > 30 | 30.0 | 28.2 | 26.8 | - 3.2 |
| 50 | > 30 | 27.4 | 25.1 | 23.8 | - 3.6 |
| 60 | > 25 | 25.4 | 22.8 | 21.7 | - 3.7 |
| 70 | > 25 | 23.8 | 21.0 | 20.2 | - 3.6 |
| 80 | > 25 | 22.8 | 20.2 | 19.7 | - 3.1 |
| 90 | > 25 | 22.2 | 20.6 | 18.6 | - 3.6 |
| 100 | > 24 | 22.1 | 19.6 | 19.0 | - 3.1 |
| 110 | > 24 | 21.6 | 19.8 | 19.5 | - 2.1 |
| 120 | > 25 | 23.5 | 20.5 | 20.1 | - 3.4 |
| 130 | > 25 | 24.1 | 20.8 | 21.0 | - 3.1 |
| 140 | > 25 | 24.9 | 21.7 | 21.6 | - 3.3 |
| 150 | > 27 | 25.7 | 23.5 | 23.4 | - 2.3 |
| 160 | > 29 | 28.1 | 27.0 | 26.8 | - 1.3 |
| 170 | > 30 | 30.3 | 29.6 | 29.2 | - 1.1 |
| 180 | > 32 | 32.6 | 32.1 | 31.9 | - 0.7 |
| 190 | > 33 | 35.5 | | 35.7 | + 0.2 |
| 200 | > 39 | 39.1 | | 39.5 | + 0.4 |
| 210 | > 45 | 45.2 | | 45.2 | 0.0 |
| 220 | > 45 | 46.4 | | 46.4 | 0.0 |
| 230 | > 45 | 45.3 | | 45.4 | + 0.1 |
| 240 | > 40 | 40.8 | | 41.2 | + 0.4 |
| 250 | > 35 | 36.4 | | 36.4 | 0.0 |
| 260 | > 30 | 31.8 | | 31.7 | - 0.1 |
| 270 | > 29 | 29.9 | | 30.0 | + 0.1 |
| 280 | > 28 | 28.9 | | 29.0 | + 0.1 |
| 290 | > 28 | 28.2 | | 28.4 | + 0.2 |
| 300 | > 27 | 27.7 | | 27.9 | + 0.2 |
| 310 | > 28 | 28.0 | | 28.2 | + 0.2 |
| 320 | > 28 | 28.2 | | 28.7 | + 0.5 |
| 330 | > 30 | 30.4 | | 30.8 | + 0.4 |
| 340 | > 33 | 33.4 | | 33.6 | + 0.2 |
| 350 | > 37 | 37.3 | 37.3 | 37.3 | 0.0 |

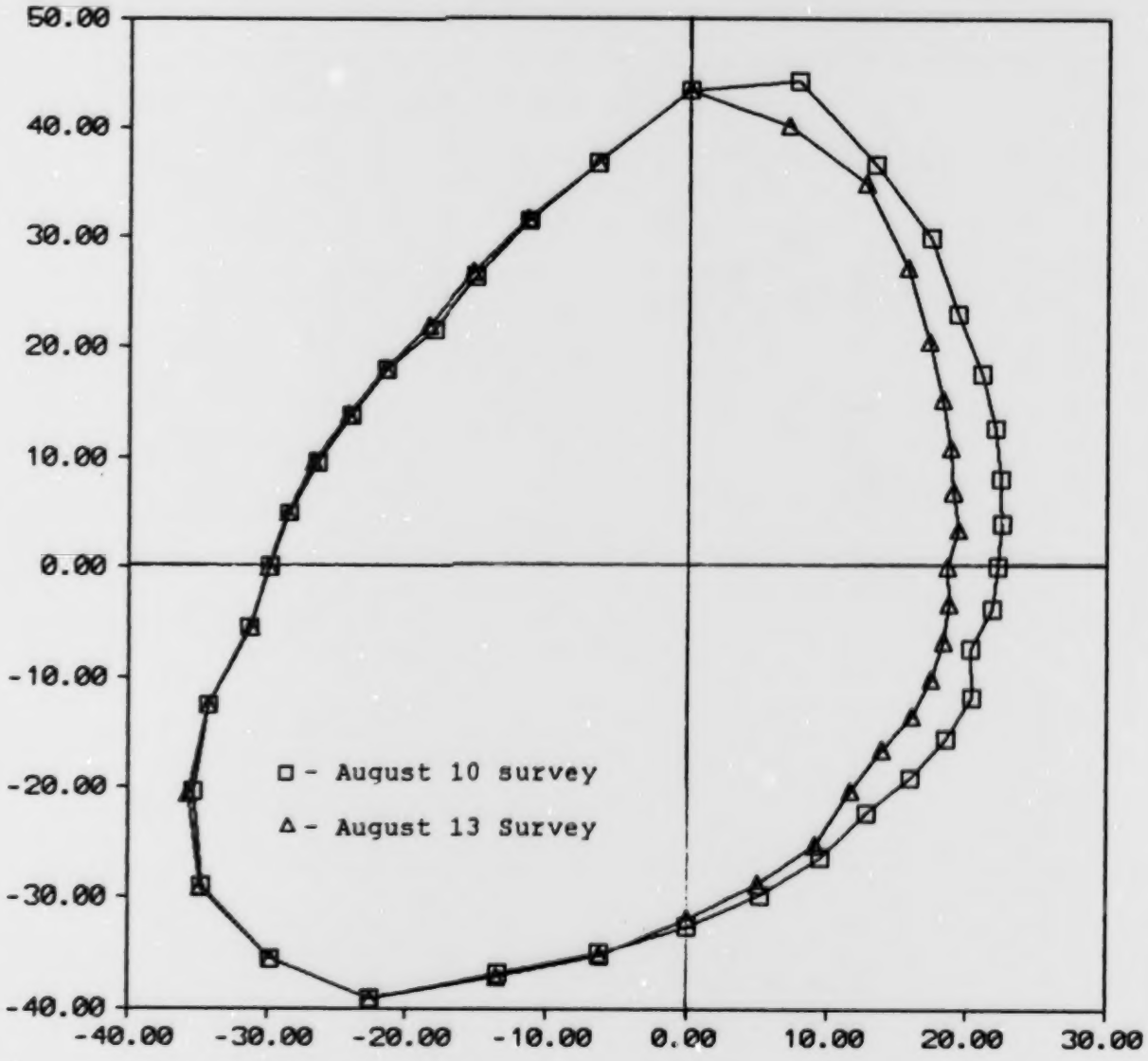



Figure 5.1 Plot of total erosion change in cliff edge between August 10 and August 13, 1986. Axes distances in metres.

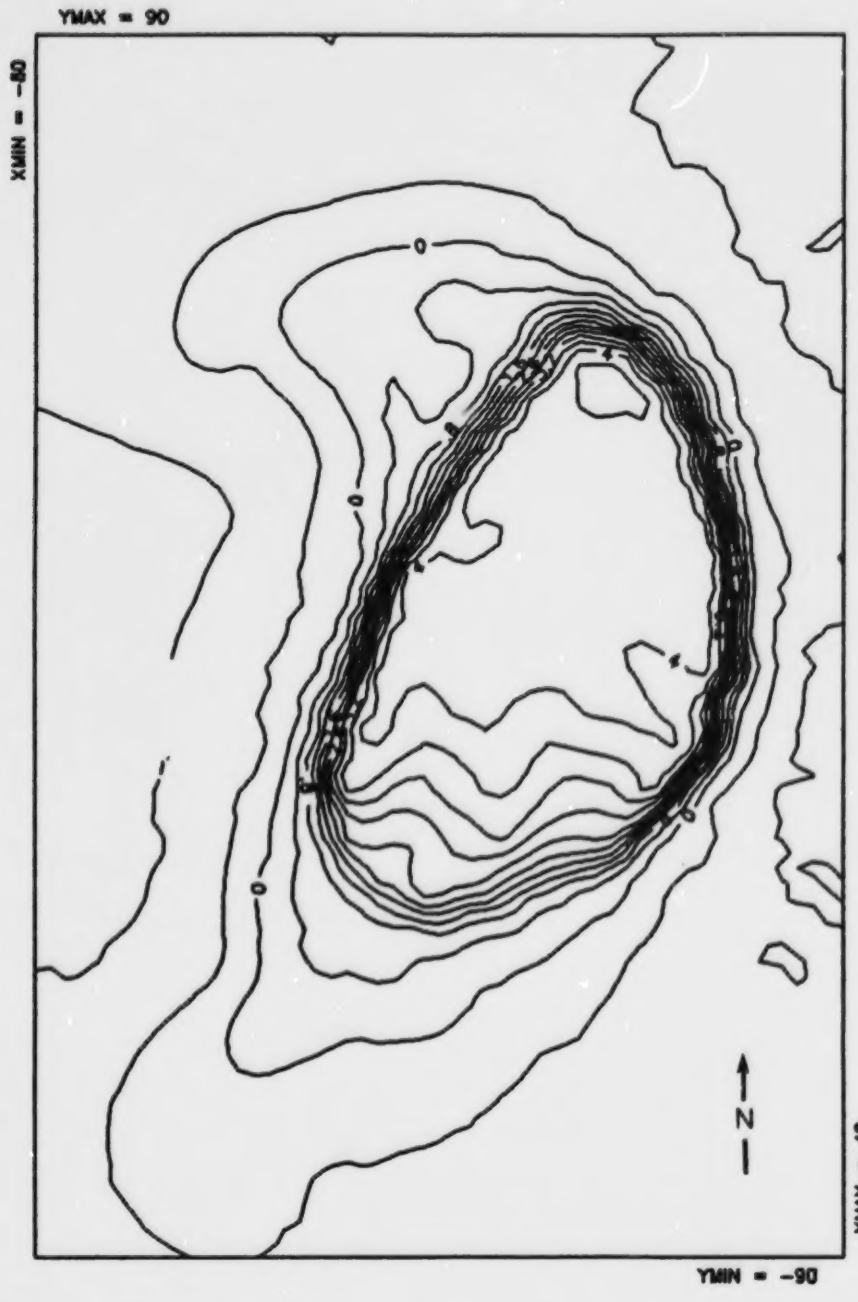



Figure 5.2 Contour plot of beach profile data only. The contour interval is 0.4 m. Contour interpolation below -0.4 m is not reliable. The scale is 1 cm = 10.13 m.

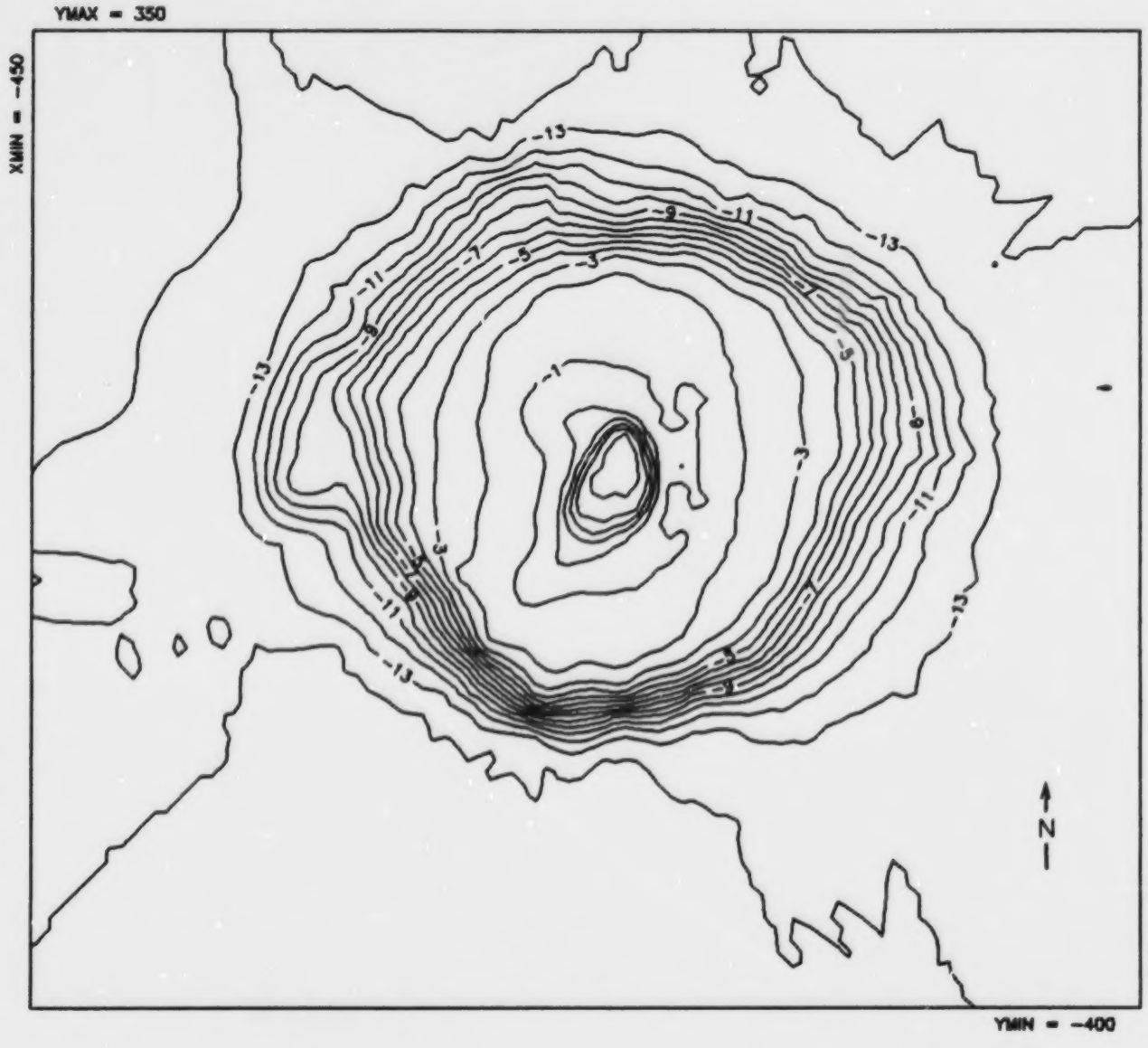



Figure 5.3 Contour plot of combined beach and echo sounding data. The contour interval is 1.0 m. Contour interpolation below - 13 m is not reliable. The scale is approx. 1 cm = 47.6 m.

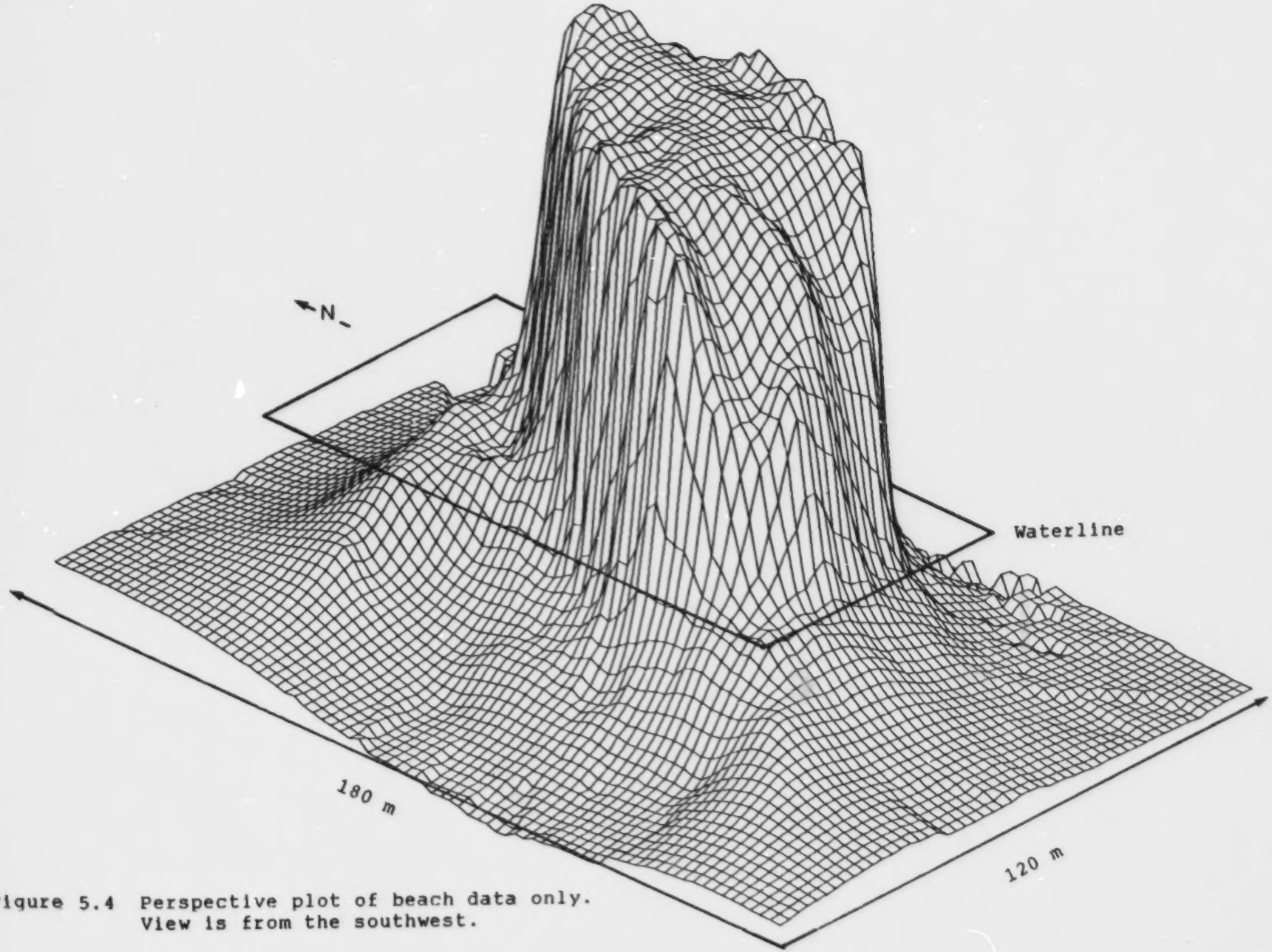



Figure 5.4 Perspective plot of beach data only.
View is from the southwest.

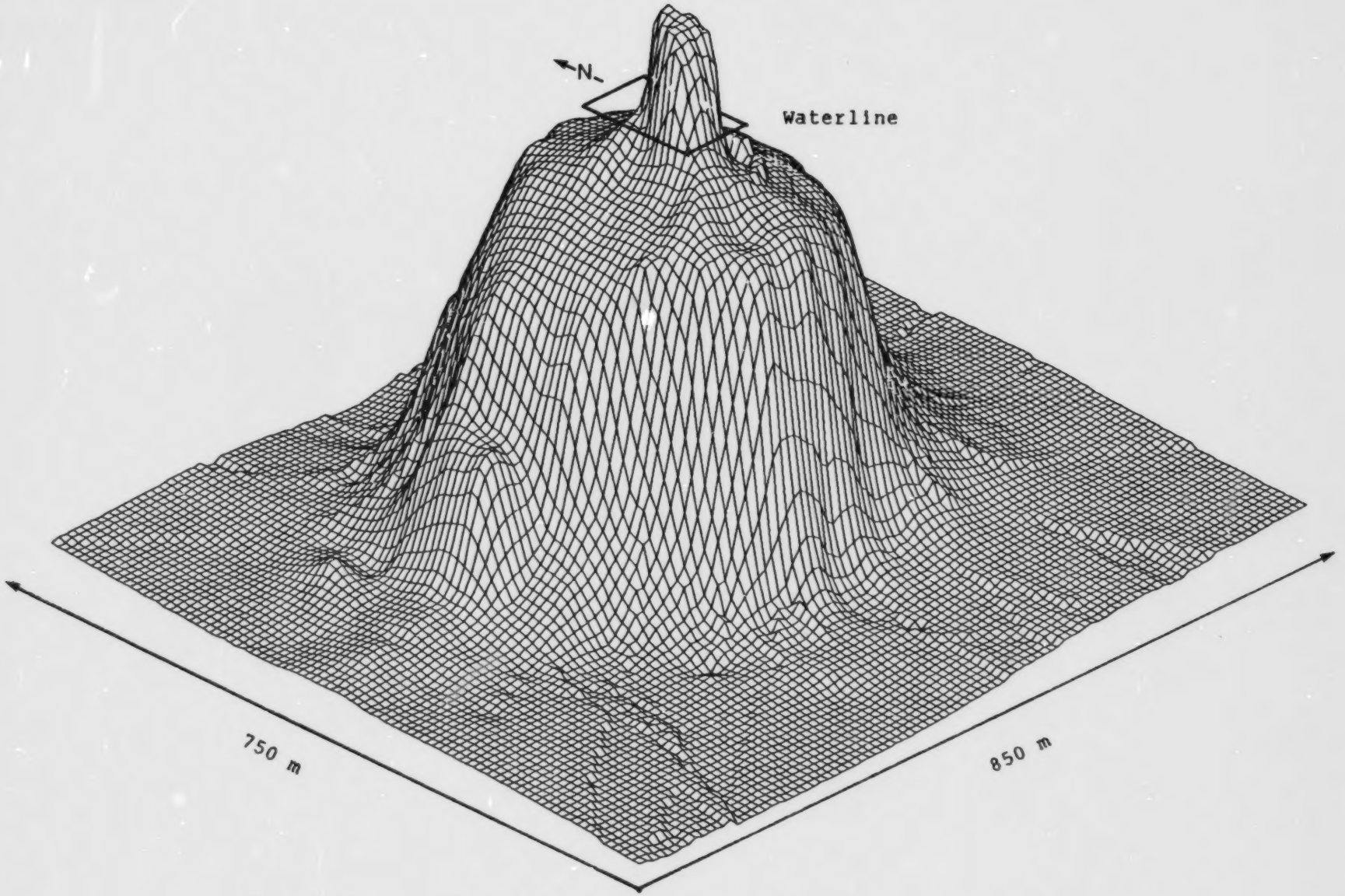



Figure 5.5 Perspective plot of combined beach and echo sounder data. View is from the southwest.

## 5.3 Comparison to CES 1984 Data

With respect to comparisons between the CES 1984 data and the 1986 data obtained in this study, it has been noted above that the coordinates for the origins of both surveys are very probably not the same. This will affect the relative horizontal positon of the 1984 and 1986 profiles. An examination of the plots of surveyed profiles reveals that there are substantial differences of up to 30 to 40 m between the horizontal position of the 1984 and 1986 data. In general, it appears that the origin for the 1986 profiles is offset approximately 20 to 30 m to the southwest of the origin for the 1984 profiles. This is apparent from the bi-modal distribution of horizontal differences present in the comparative profiles. Specifically, horizontal differences are maximum between lines 020 to 080 and lines 200 to 280, whereas there is none or very little horizontal difference in lines 140 and 320. Therefore, a shift in the 1986 origin by 20 to 30 m to the northeast would likely eliminate most of the horizontal differences present. However, given this uncertainity of origin position,it is unlikely that reliable estimates of profile changes due to sediment transport phenonmena can be derived.

## 6.0 REFERENCES

Canadian Engineering Surveys Co. Ltd., 1984: Itiyok Island, Survey No, 1. Bathymetric Plot and Contour Plot. Survey conducted August 17, 1984.

Environmental Studies Revolving Funds, 1985: Beaufort Sea Artificial Island Erosion Data, Request for Proprosal. E.S.R.F. UPDATE, Vol. III (2).

Hodgins, D. O., D. A. Huntley, W. D. Liam Finn, B. Long, G. Drapeau, and A. J. Bowen, 1986: Bottom Sediment Transport -- Present Knowledge and Industry Needs. Environemntal Studies Revolving Funds Report 027. Ottawa. 394 p.

Hodgins, D. O., O. J. Sayao, E. D. Kinsella and P. W. Morgan, 1986: Nearshore Sediment Dynamics - Beaufort Sea. The 1986 Monitoring Program. Environmental Studies Revolving Funds Report 054. 195 p.

# WEATHER, WAVE OBSERVATIONS AND MISCELLANEOUS DATA

## ITIYOK ISLAND FIELD SURVEY

## AUGUST 5-15, 1986

Note: All times are local, MDT.

August 7, 1986

08:10 Calibration of Electronic Distance Measuring (EDM) instrument against survey tape distances.

| Tape Distance (m) | EDM Distance (m) |
|---|---|
| 50.0 | 49.5 |
| 100.0 | 99.6 |
| 150.0 | 149.6 |
| 200.0 | 199.4 |
| 250.0 | 249.4 |
| 300.0 | 299.4 |

09:00 Calibration of Topcon level per pages 18 and 19 of instrument manual. Level reading is within 1-2 mm of level over a distance of 50 metres.

August 8, 1986

06:30 Offshore weather at ARNAK consists of low fog with limited visibility (100 foot ceiling and 1/4 mile visibility).

12:00 ARNAK still fogged-in.

18:00 Enroute to ITIYOK from ARNAK. Patchy fog with less than 0.5 mile visibility. Wind E to NE at 5 knots. Seas less than 0.5 m.

18:40 Fog clearing. Visual siting of ITIYOK approx. five miles ahead. No image on boat radar. ITIYOK visible on radar screen at two miles range. Wind now 5-10 knots with occasional whitecaps.

19:01 Off ITIYOK. Vertical sand cliffs of 3-4 m height on north to southeast sides and lower slopes on remaining sides. Wing bars located on southwest and northwest sides. Remnants of sandbag material litter the seabed inside the 2 m depth around the island, especially on southwest side between the two wing bars. The Immerk will not approach or beach on the island for fear of sandbag fabric wrapping around propellor shafts.

20:50 Central B.M. and circle of survey line markers at 10 degree arc increments installed and marked. Wind has risen to 10 - 15 knots. Whitecaps present everywhere. Seas 0.5 to 1 m.

August 9, 1986

00:05 Complete levelling of island top surface to within 1-2 m of cliff edge which is actively eroding on the north to southeast sides. Wind now E to NE at 12-20 knots. Seas 1 1.5 m. Very little shelter from waves in lee of island beyond 100 m from the shore. Sea conditions too rough to echo sound.

07:00 Winds are NE 15-20 knots with gale warning for later today and August 10.

August 10, 1986

12:09 Arrive ITIYOK. Winds are from NE at 5-10 knots. Seas are 0.5 to 1 m. Visibility limited by fog. Complete levelling survey of island down to approx. 1 m below MSL. Install and level-in water level gauge. Commence echo sounding survey. Wind and seas rising from the NE later in day.

August 11, 1986

00:05 Terminate echo sounding on lee side (SW) of island. Aluminum survey skiff having trouble following survey line bearing because of wind and sea conditions. Wind: E to NE, 15-20 knots. Waves: 1-2 m with whitecaps everywhere. Fog approaching from the NE.

00:45 Depart ITIYOK for ARNAK.

13:00 Depart ANARK for ITIYOK. Wind less than 5 knots, seas 0.5 to 1 m from NE.

14:30 Arrive ITIYOK. Wind NE 10 knots, seas 0.5 to 1.5 m.

August 12, 1986

15:20 Arrive ITIYOK. Wind from NE less than 5 knots, seas less than 0.5 m, visibility less than 100-200 m.

17:30 Fog too thick to see survey boat at 100 m. Conduct survey of cliff top edge at lines 350 through 90 to 180. There appears to have been about 2 m of horizontal erosion of the cliff top edge since the last survey on August 10.

August 13, 1986

11:30 Arrive ITIYOK. Wind NE at 5 knots, seas 0.5 to 1 m, fog with visibility of 500 m becoming less than 100 m. Survey with boat and echo sounder using transit level horizontal angles for positioning. Re-survey cliff top edge for erosion change.

17:10 Complete surveying activities.

17:45 Depart ITIYOK for Kamotik anchored off ARNAK.

20:30 Wind NE at 10 knots, seas 0.5 to 1 m, no fog. ITIYOK reported to be clear.

23:00 Arrive off ITIYOK, resume echo sounder surveying using EDM for positioning.

August 14, 1986

01:15 Fog moves in after completing nine survey lines. Abort further surveying.

# WEATHER, WAVE OBSERVATIONS AND MISCELLANEOUS DATA

## ITIYOK ISLAND FIELD SURVEY

## SEPTEMBER 9-17, 1986

Note: All times are local, MDT.

September 10, 1986

15:00 Meet with CEVO technician re installation of Syledis positioning system on survey vessel.

September 13, 1986

07:00 Tuk Harbour. Weather: Snowflurries, wind W to NW 15 knots with squalls to 20 knots.

09:30 Off entrance to Tuk Harbour. Wind WNW at 15-20 knots, seas 1-2 m.

10:10 Only making 2-3 knots into northwest wind and waves. Taking solid water from larger waves over the bow. Decide to turn back to Tuk Harbour.

September 14, 1986

07:10 Depart Tuk Harbour.

08:35 Pass by ARNAK artificial island. Winds SE 15-20 knots, seas 1-2 m.

12:00 Arrive ITIYOK island. Circle island, now a shoal marked by a line of breaking waves. Winds SE 20 knots, waves 1-2 m with whitecaps everywhere with some blowing spray. Beaufort Sea State scale FOUR to FIVE. Too rough to survey or operate boat safely. Decide to head to shelter off Pullen Island approx. 12 nm to the southwest. Must steer to the southeast directly into the seas then turn to the southwest once closer to the shore where waves are smaller. Making about 4 knots into the wind before turning to the SW.

14:15 Arrive off Pullen Island. Wind SE 15-20 knots.

15:45 Weather forecast from Gulf Nullak Base indicates continuing SE 20-30 knot winds for next 24 hours.

18:00 Wind continued to blow SE all day.

September 15, 1986

05:00 Wind came up during the night to about 20-30 knots.

08:10 Weather forecast for SSE 20-28 knots today, switching to WSW 12-18 tomorrow.

09:00 Weather report for AMAULIGAK: wind SE at 20 knots, seas of 1.5 m.

19:00 Wind SE all day.

23:00 Wind dying off to less than 15 knots and switching more to east.

September 16, 1986

00:00 Wind veered to east causing local seas to rise.

02:00 Wind backed around to SE again.

06:00 Wind SE 15 knots.

07:00 Weather report for AMAULIGAK: wind SE at 22 knots, seas of 1 m. Weather forecast for winds SE at 20 knots, switching to WNW at 25-35 knots at 06:00, September 17.

08:40 Depart Pullen Island for Tuk Harbour.

09:10 Wind SE 15, seas 1 m, water depth 4 m.

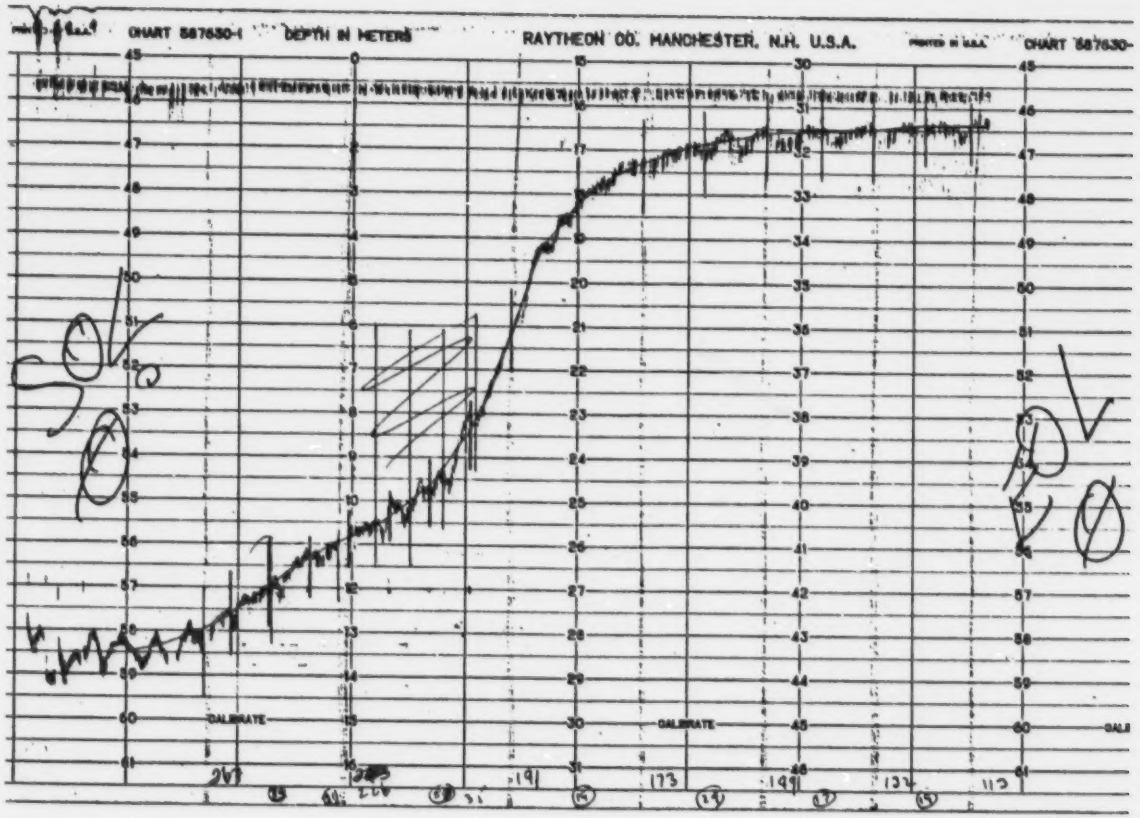
10:30 Reach ARNAK artificial island. Wind SE 15-20 knots, seas 1-2 m.

12:45 Approx. 8 nm to Tuk Harbour. Wind SE 20-25 knots, seas 1-2 m.

# PHOTOCOPIES OF
# ECHO SOUNDER RECORDINGS

## ECHO SOUNDER RECORDING

Location: Itiyok Island
Profile: Line 000
Date: 13/08/86



**ECHO SOUNDER RECORDING**

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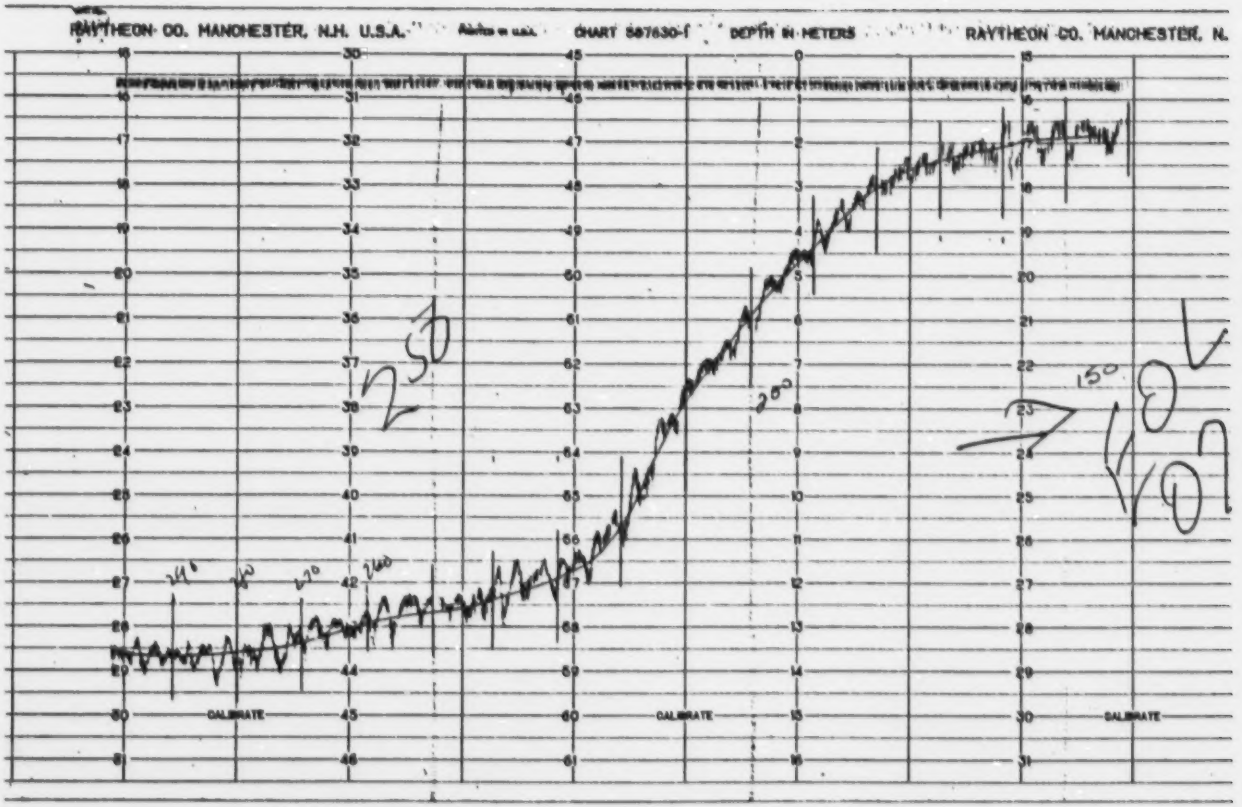
**Profile:** Line 020
**Date:** 13/08/86



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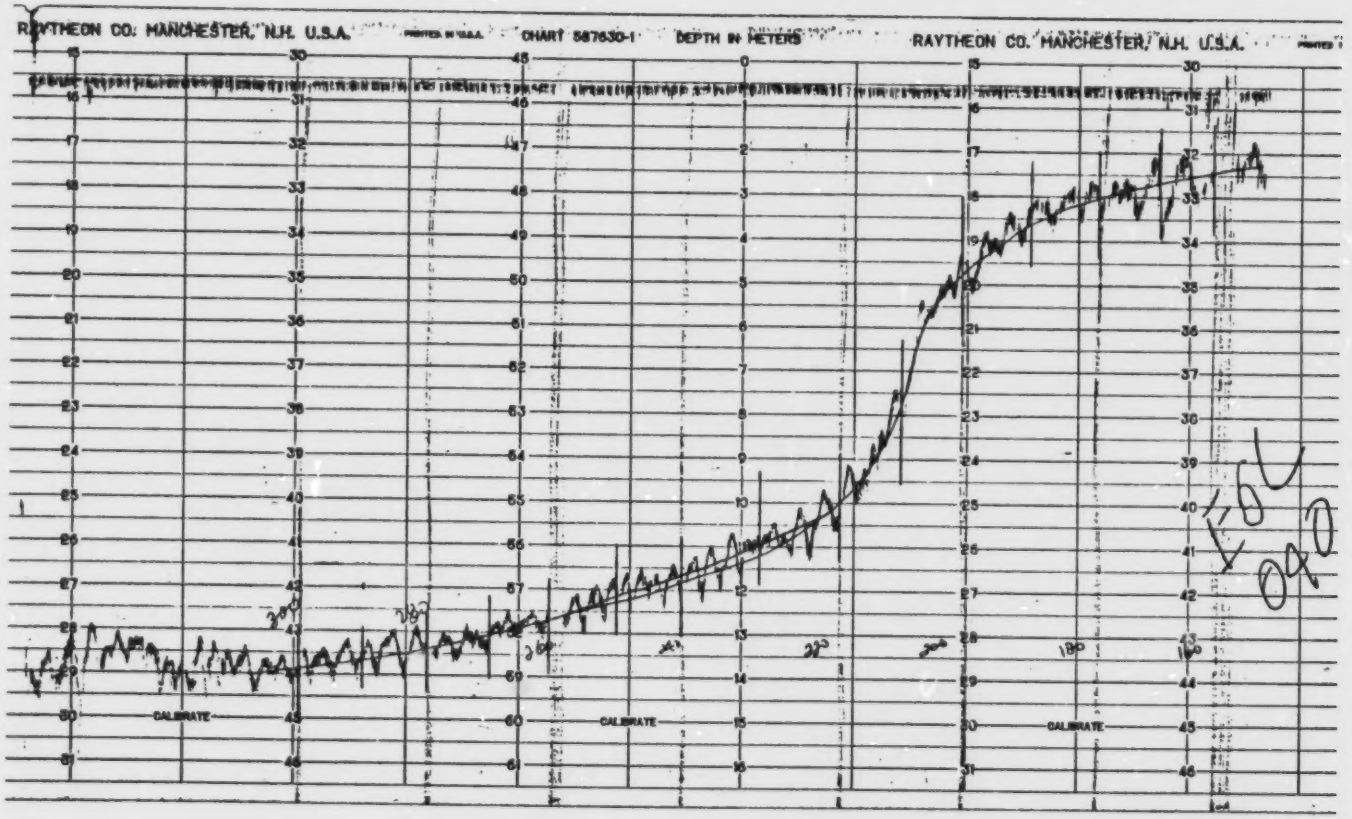
Date: 13/08/86



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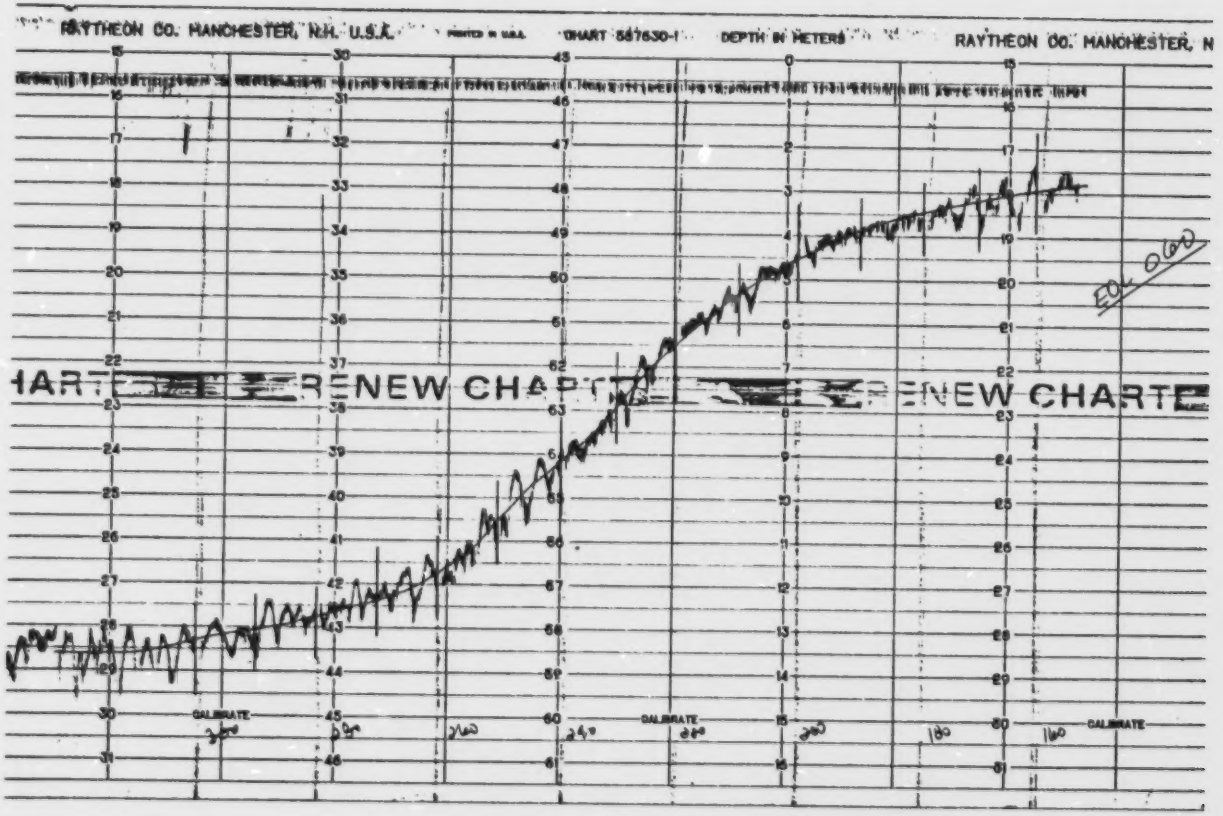

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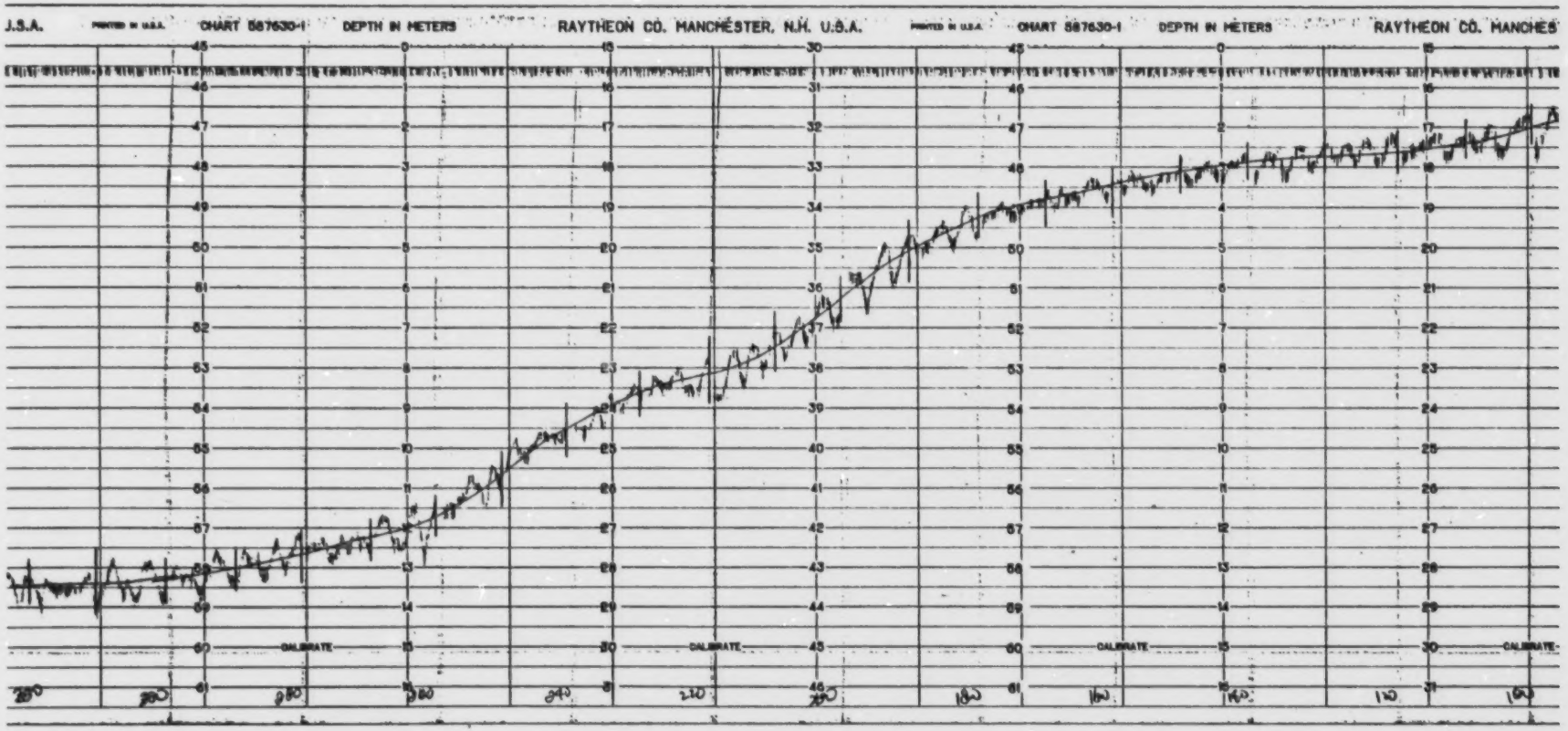

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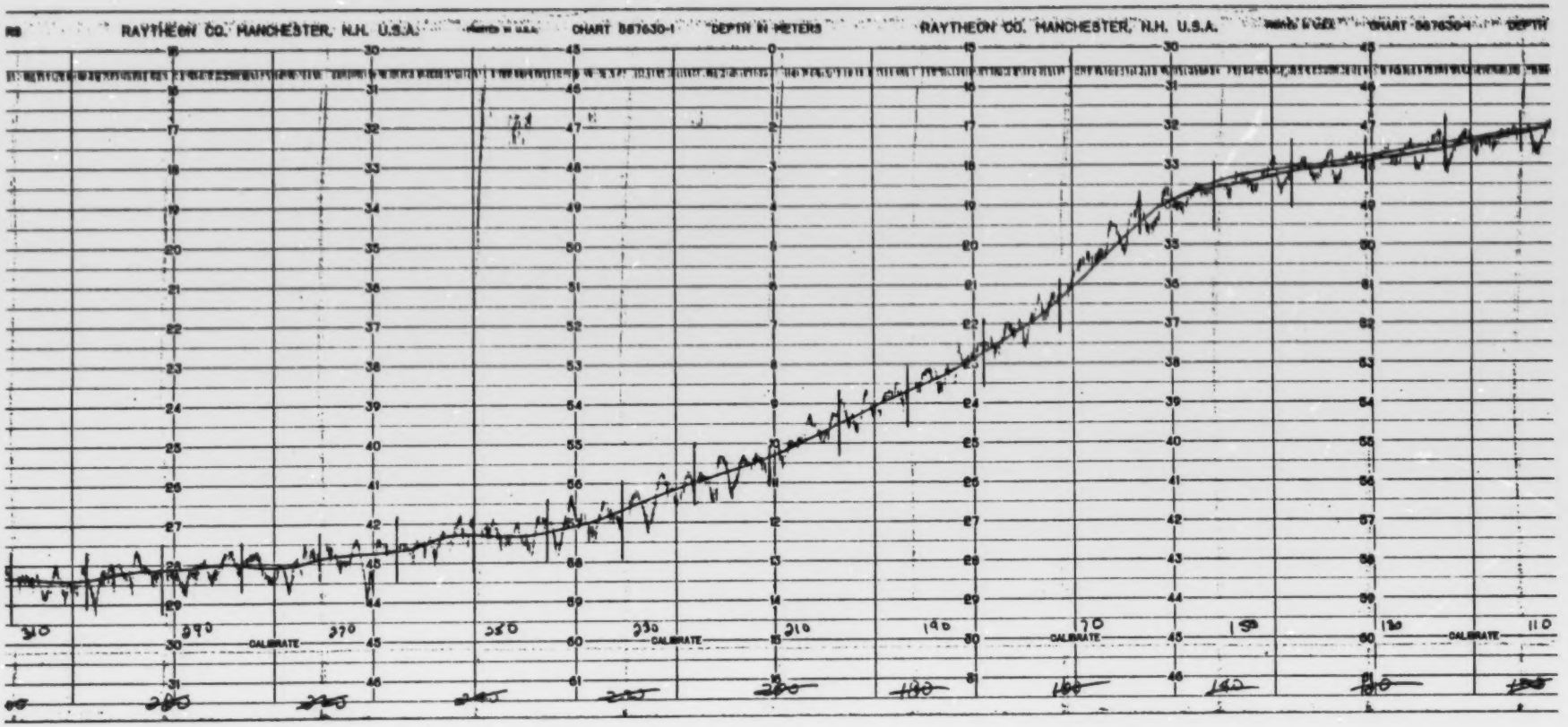
Date: 13/08/86



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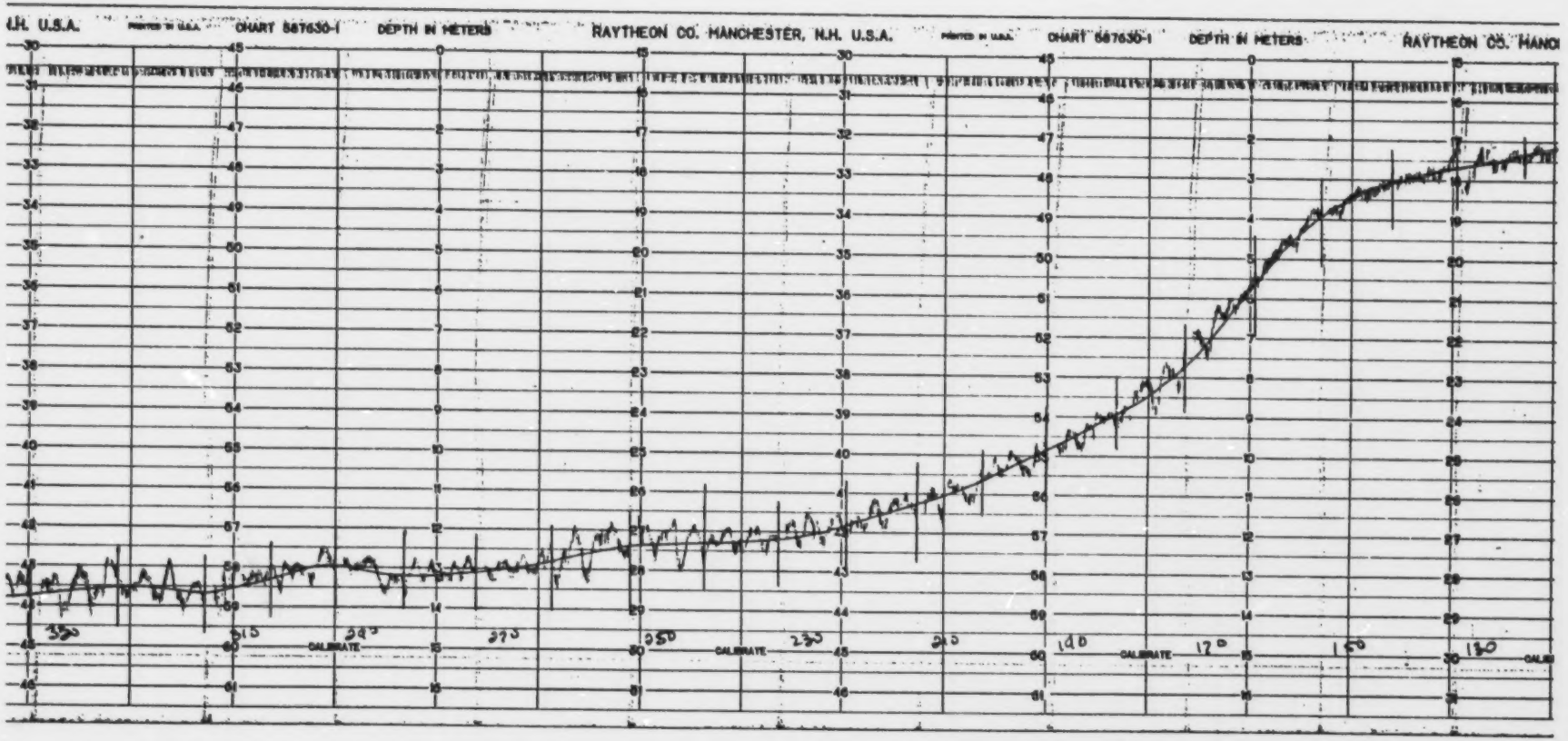

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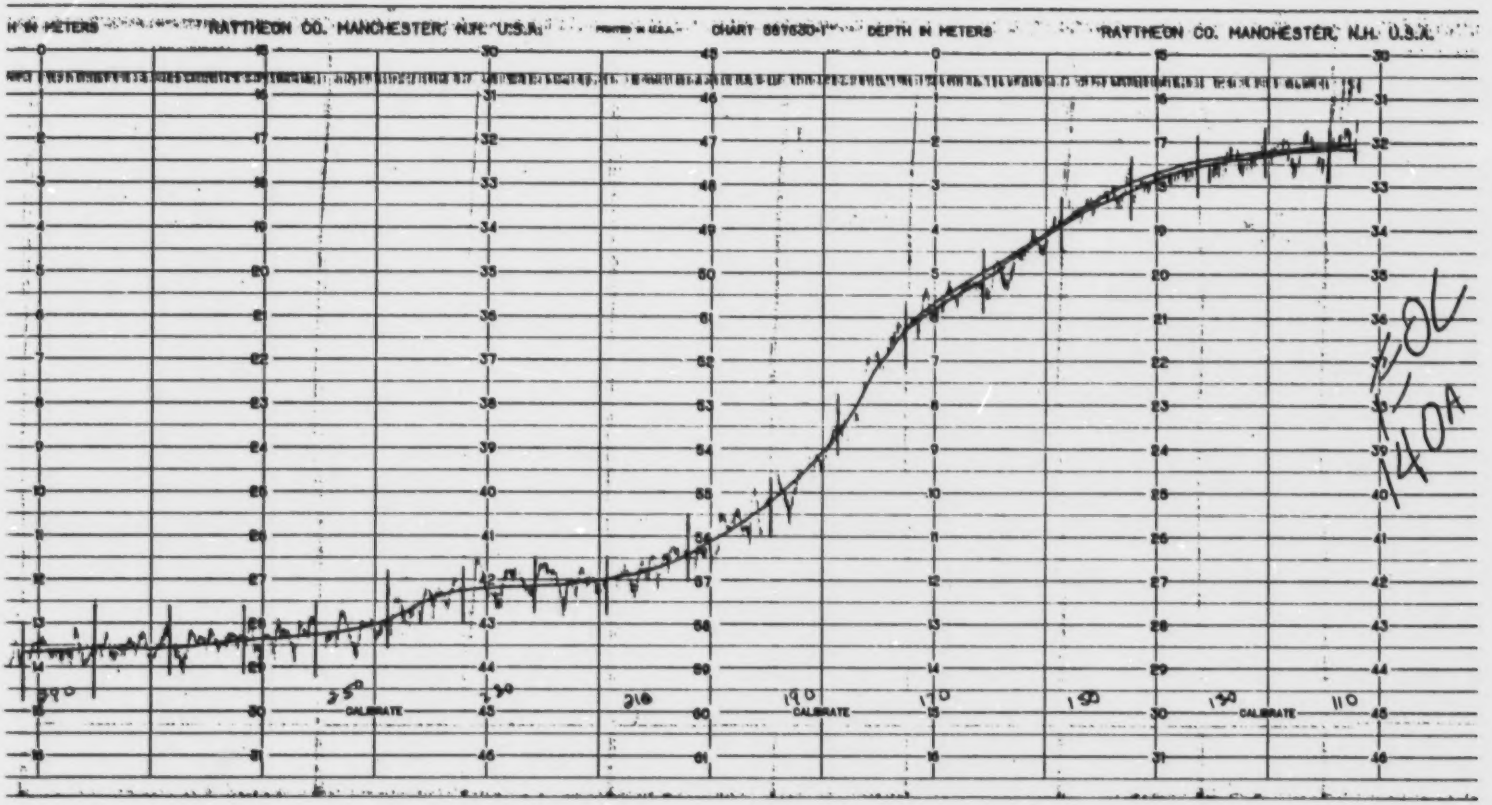
Date: 13/08/86



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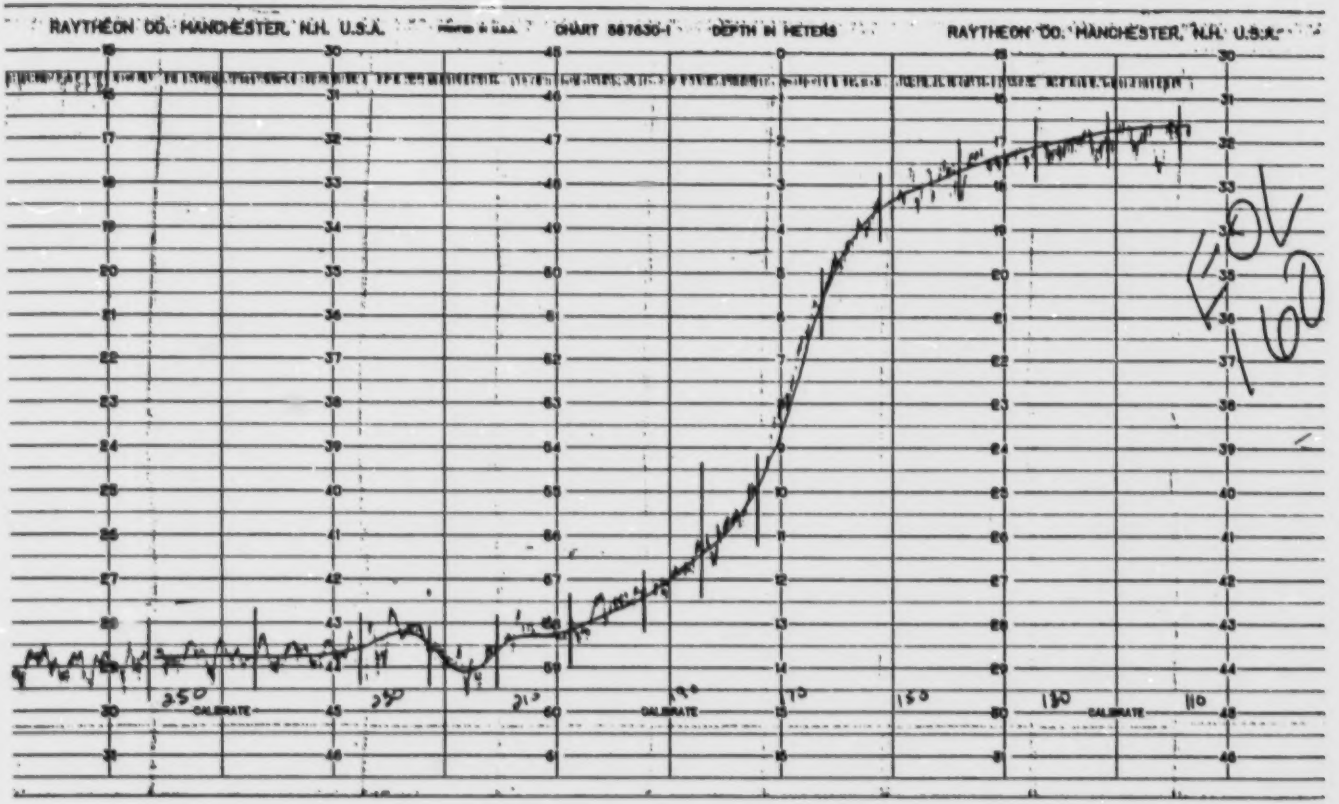

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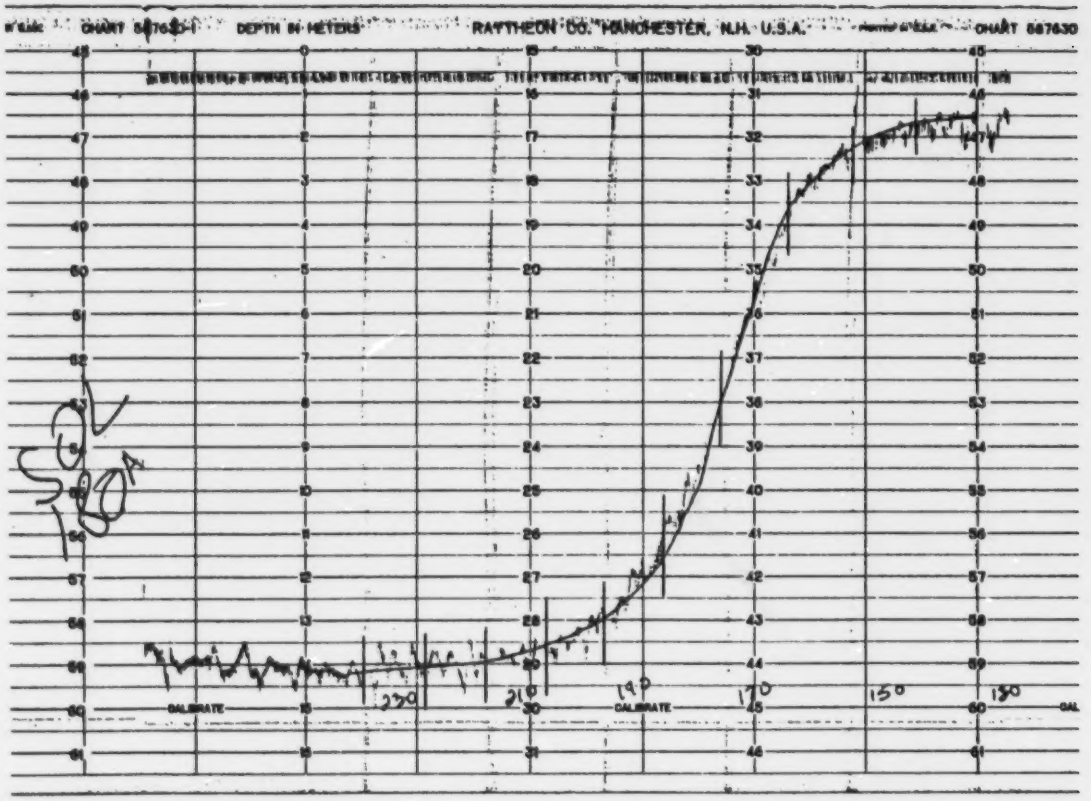

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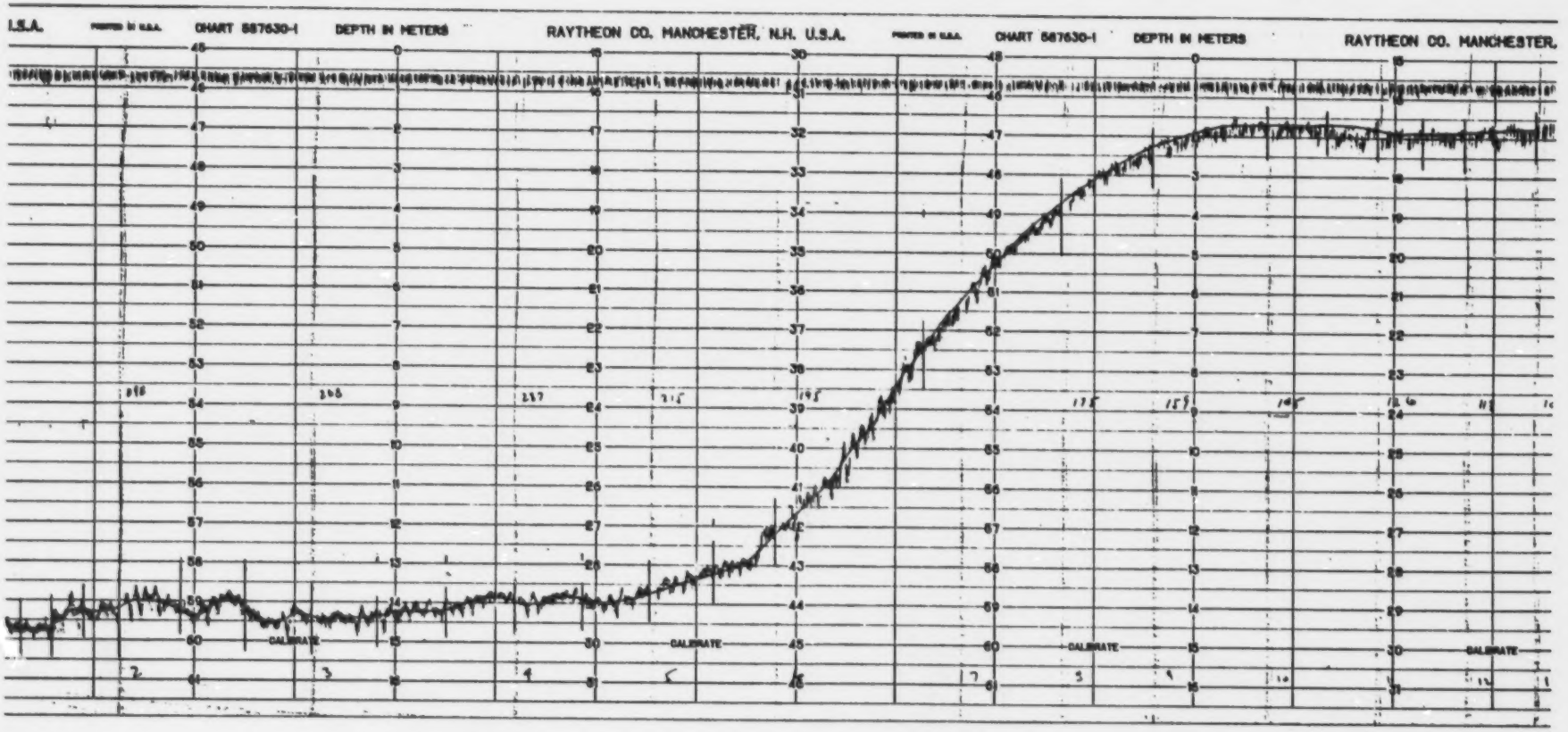

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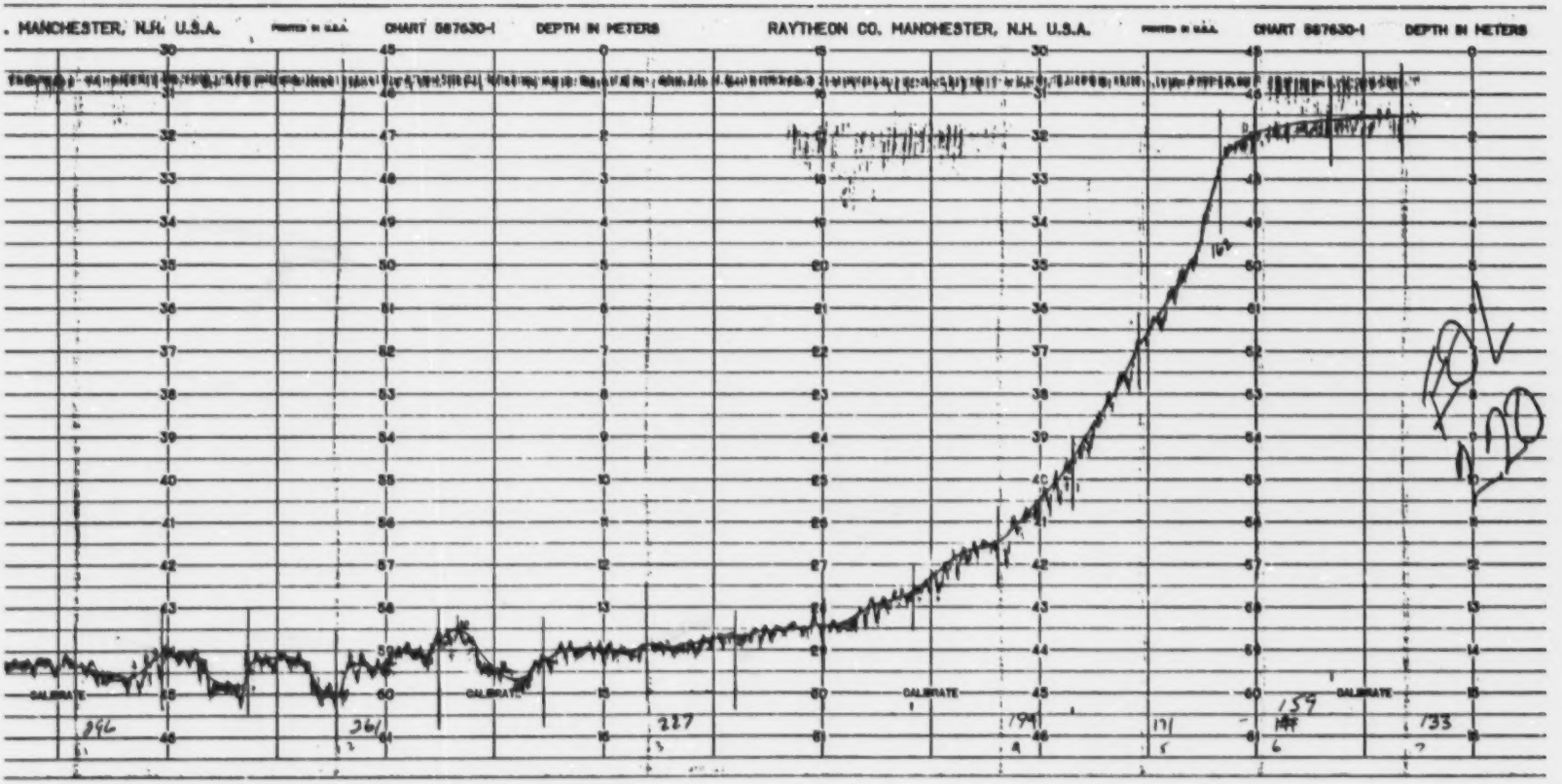

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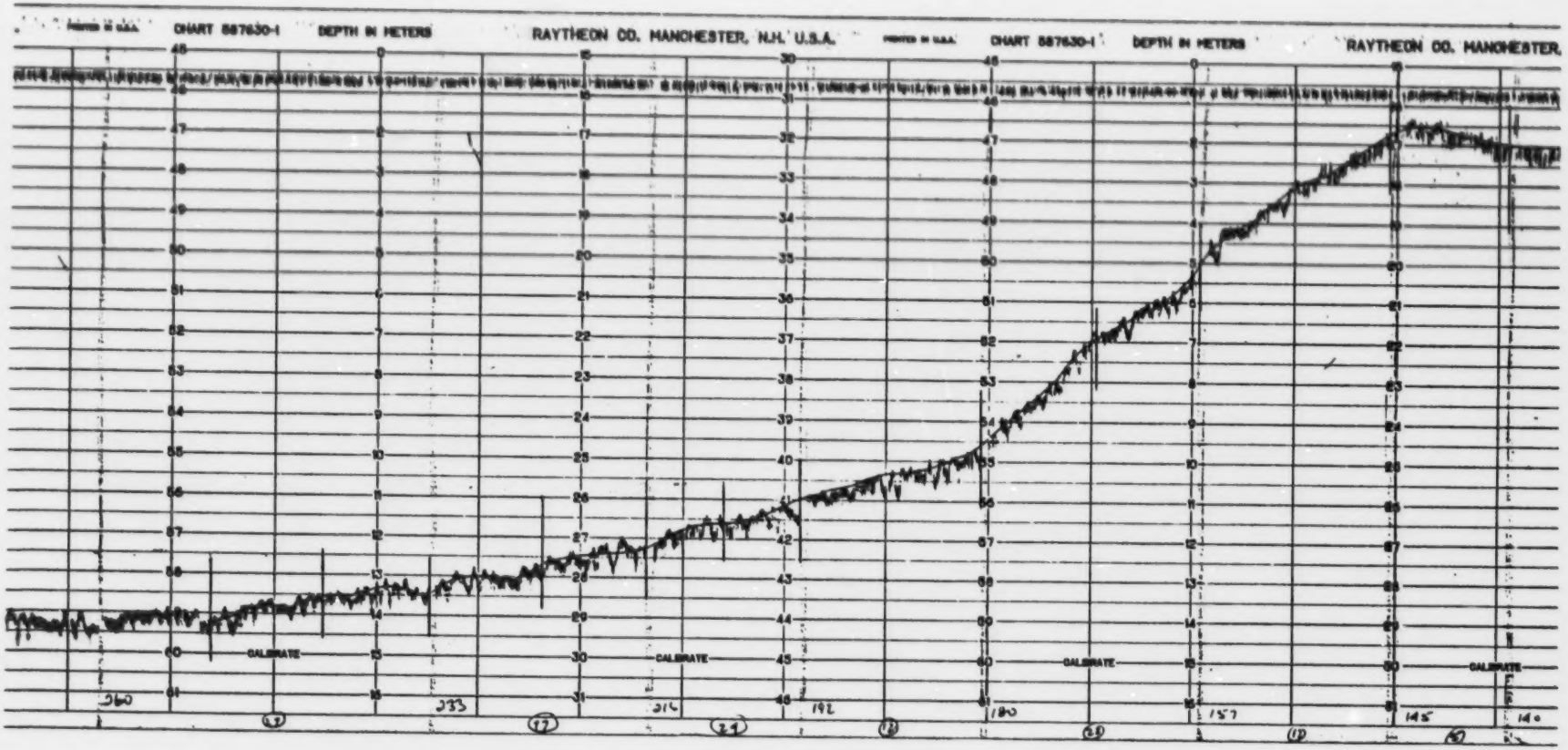
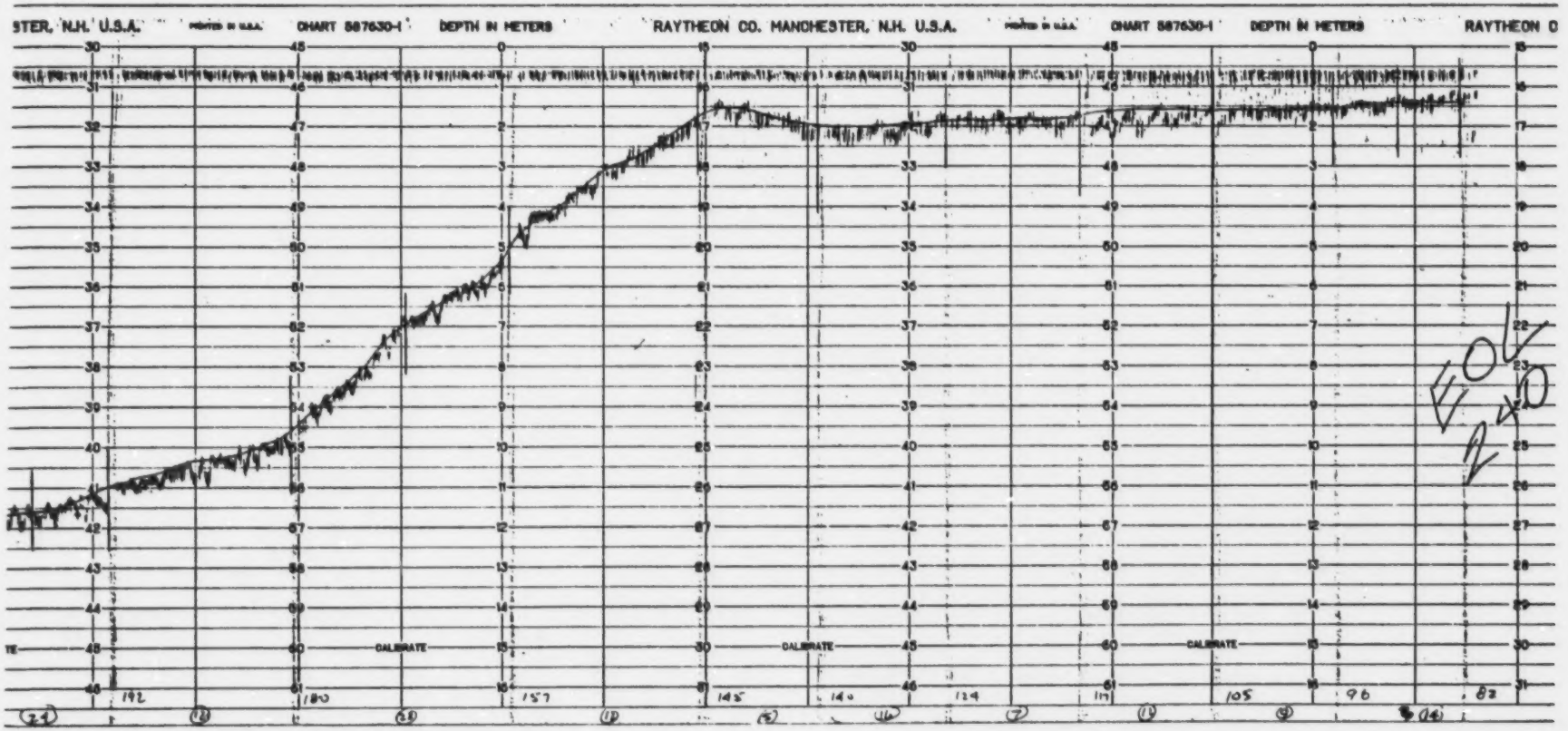


**ECHO SOUNDER RECORDING**

Location: Itiyok Island
Profile: Line 240 Continued
Date: 13/08/86



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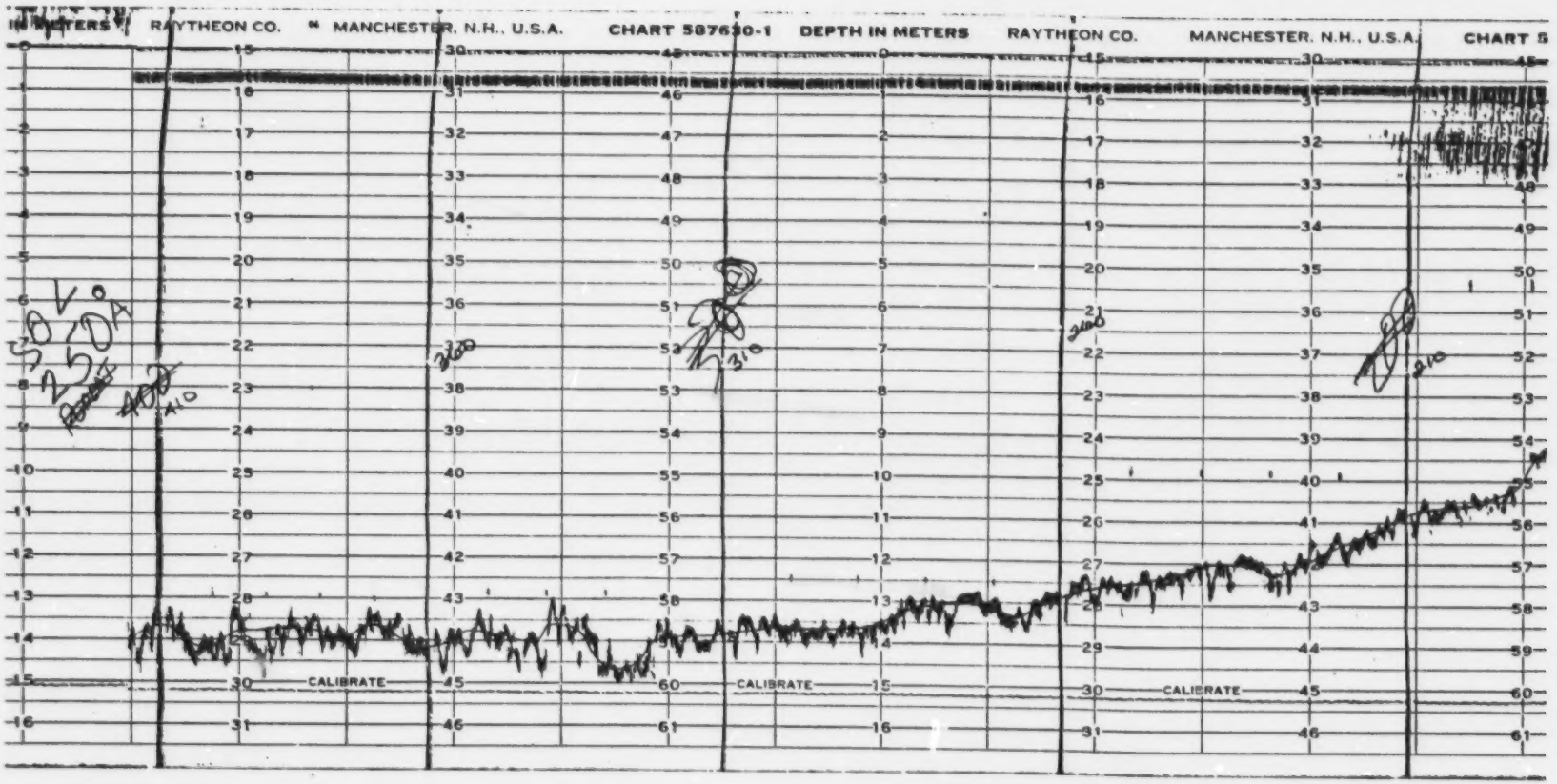
Date: 10/08/86



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Location: Itiyok Island
Profile: Line 250 Continued
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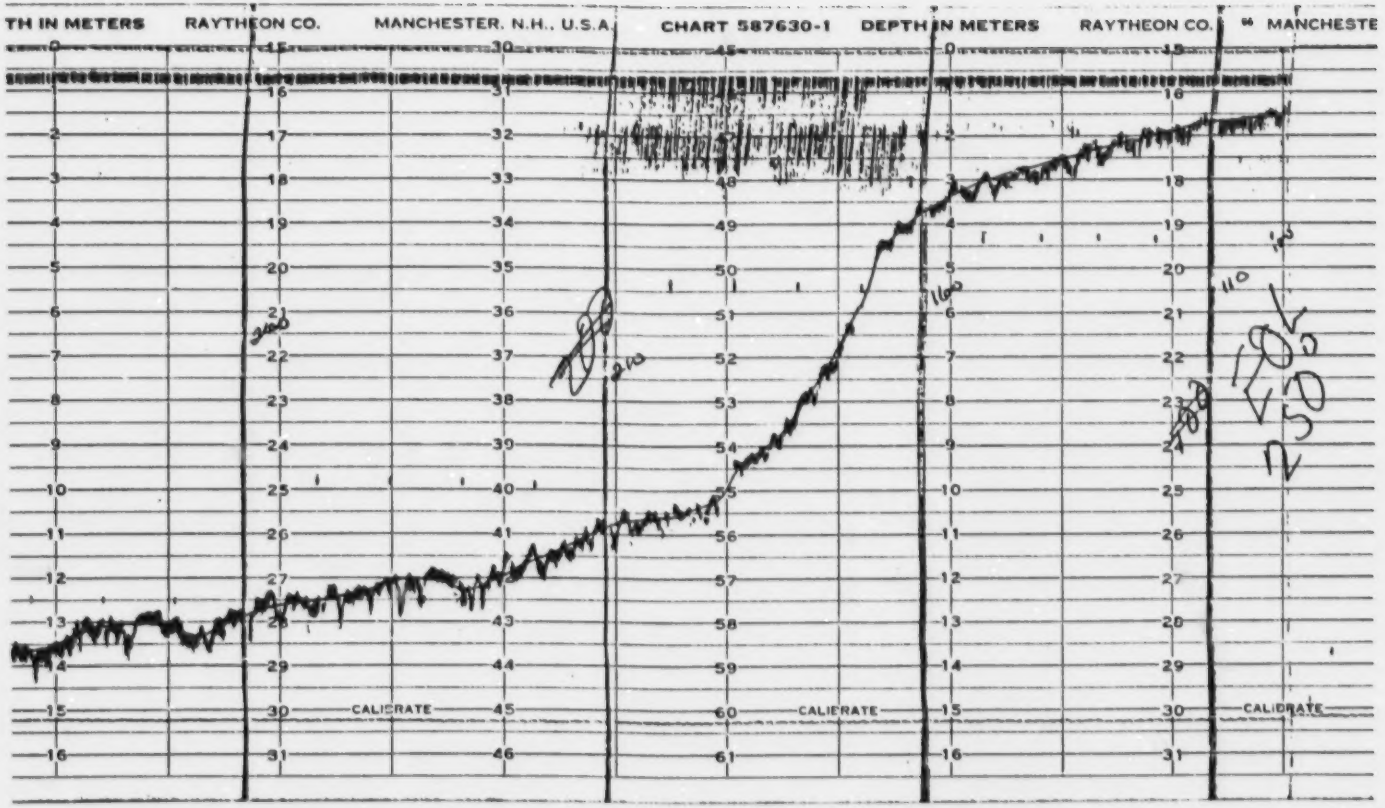

ECHO SOUNDER RECORDING

Location: Itiyok Island
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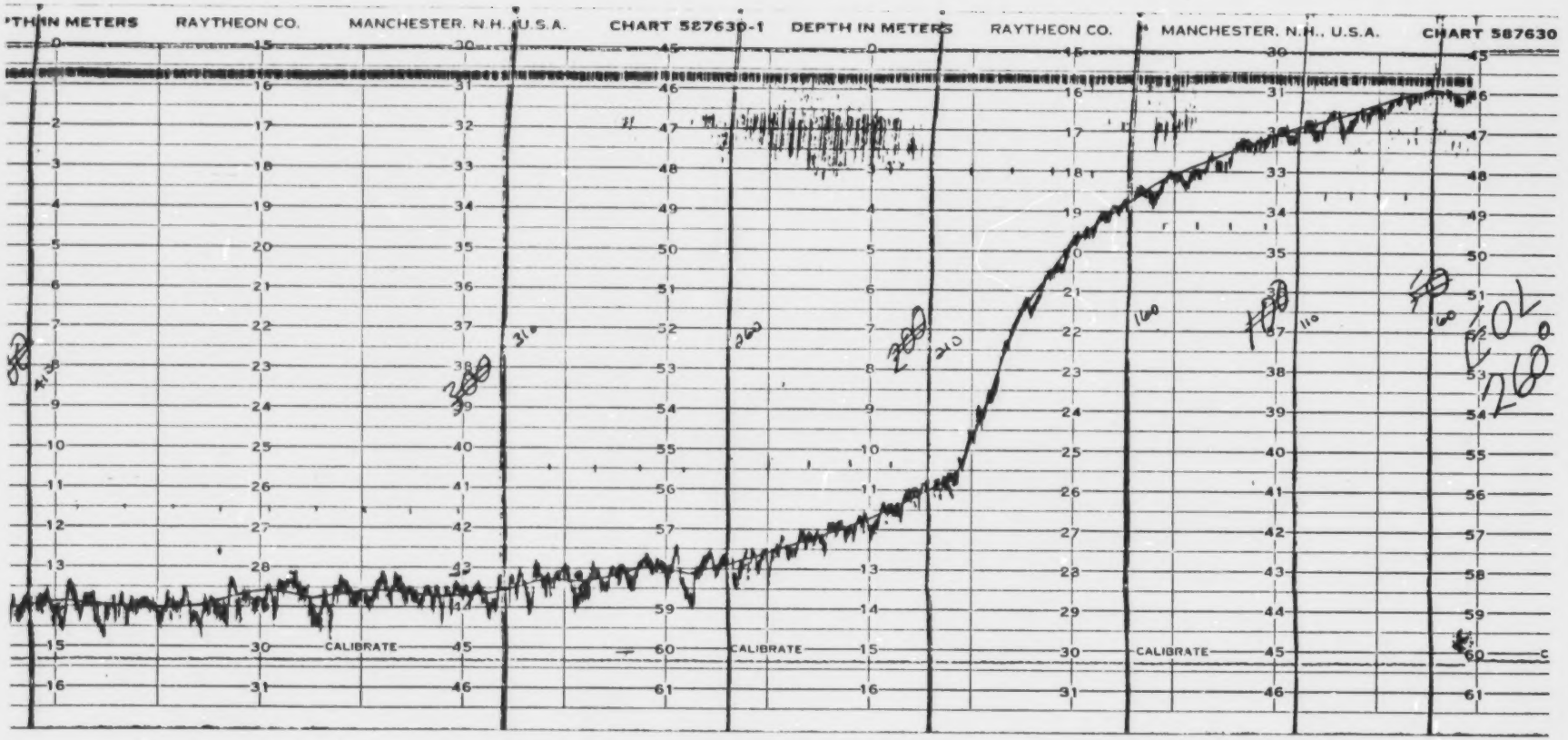

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Location: Itiyok Island
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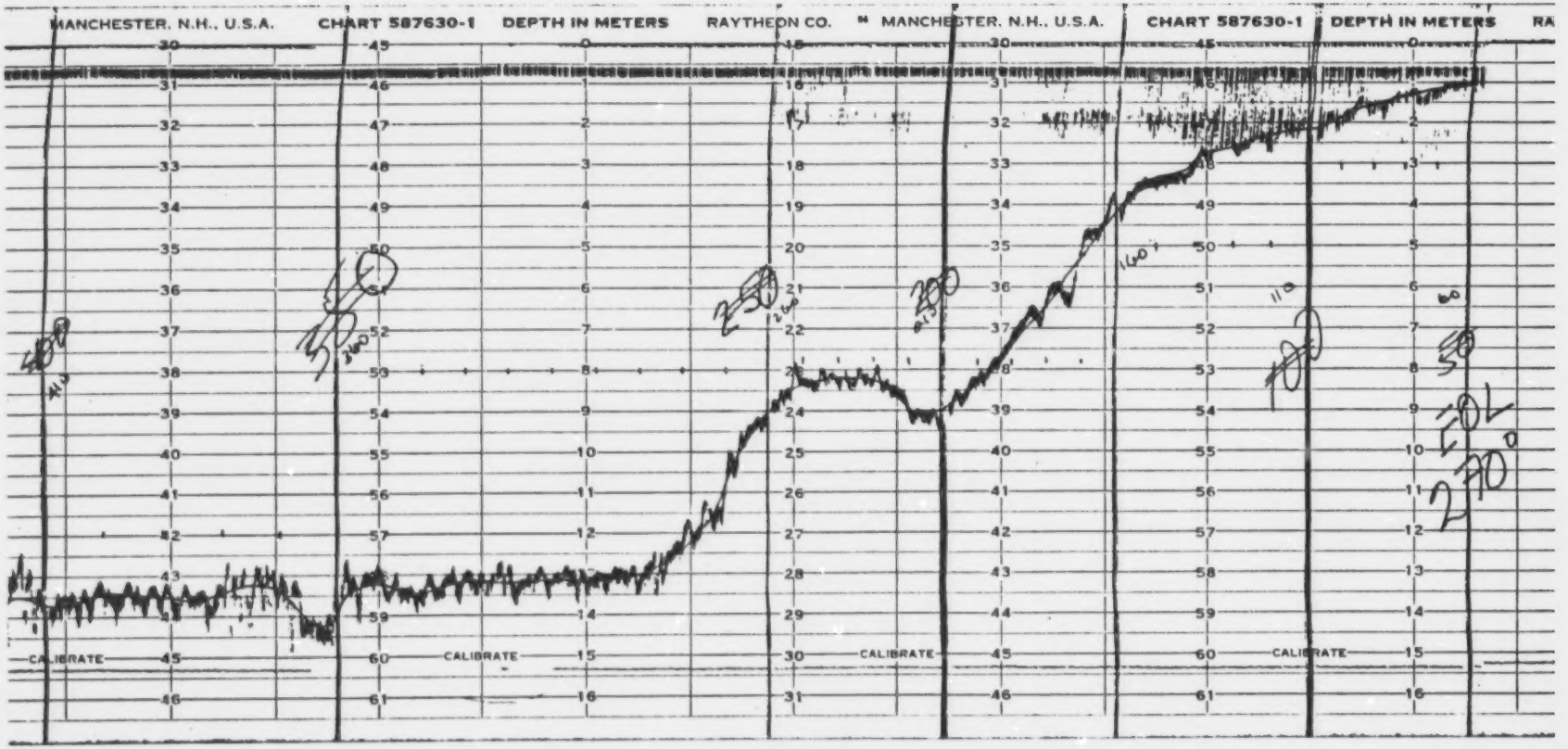

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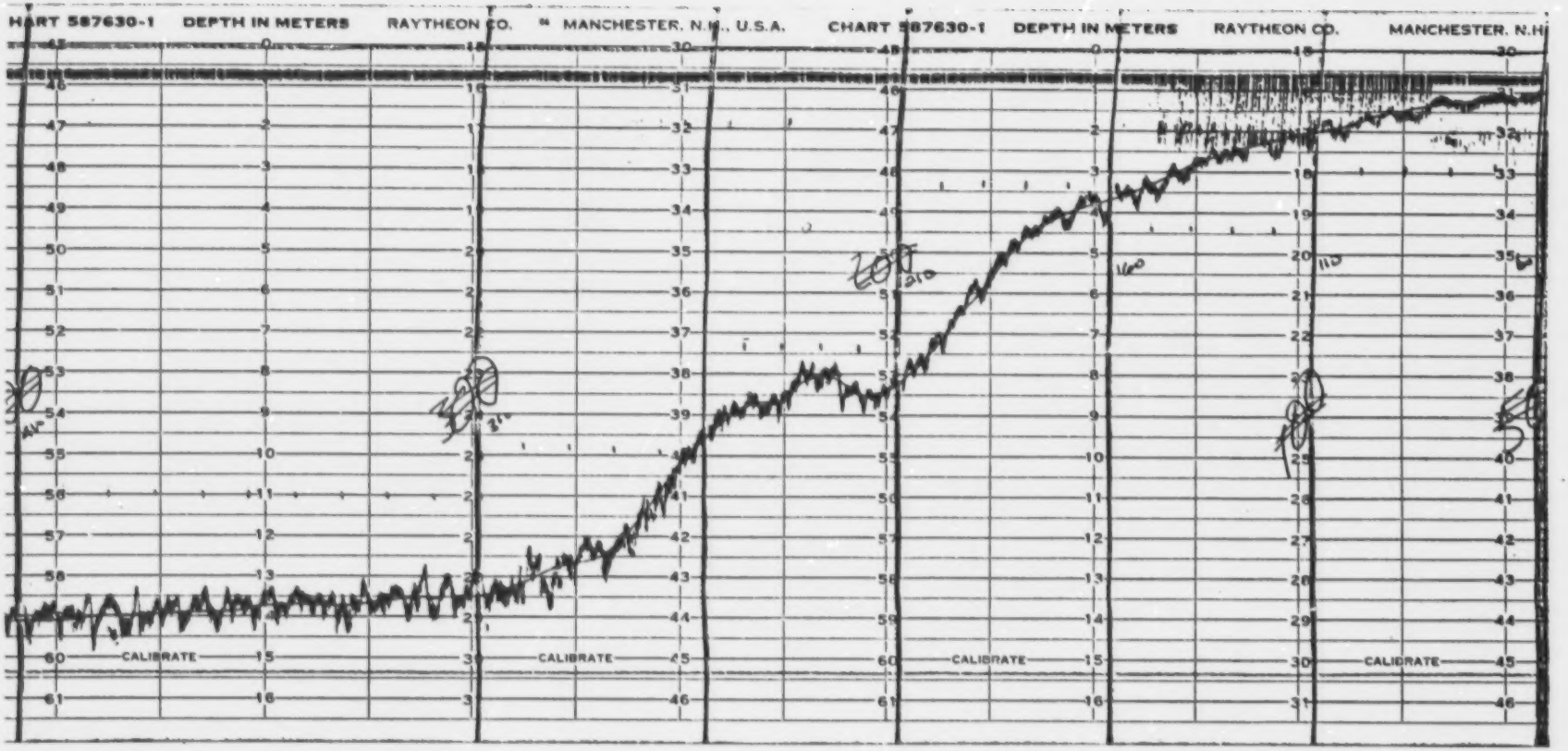
Date: 10/08/86



## ECHO SOUNDER RECORDING

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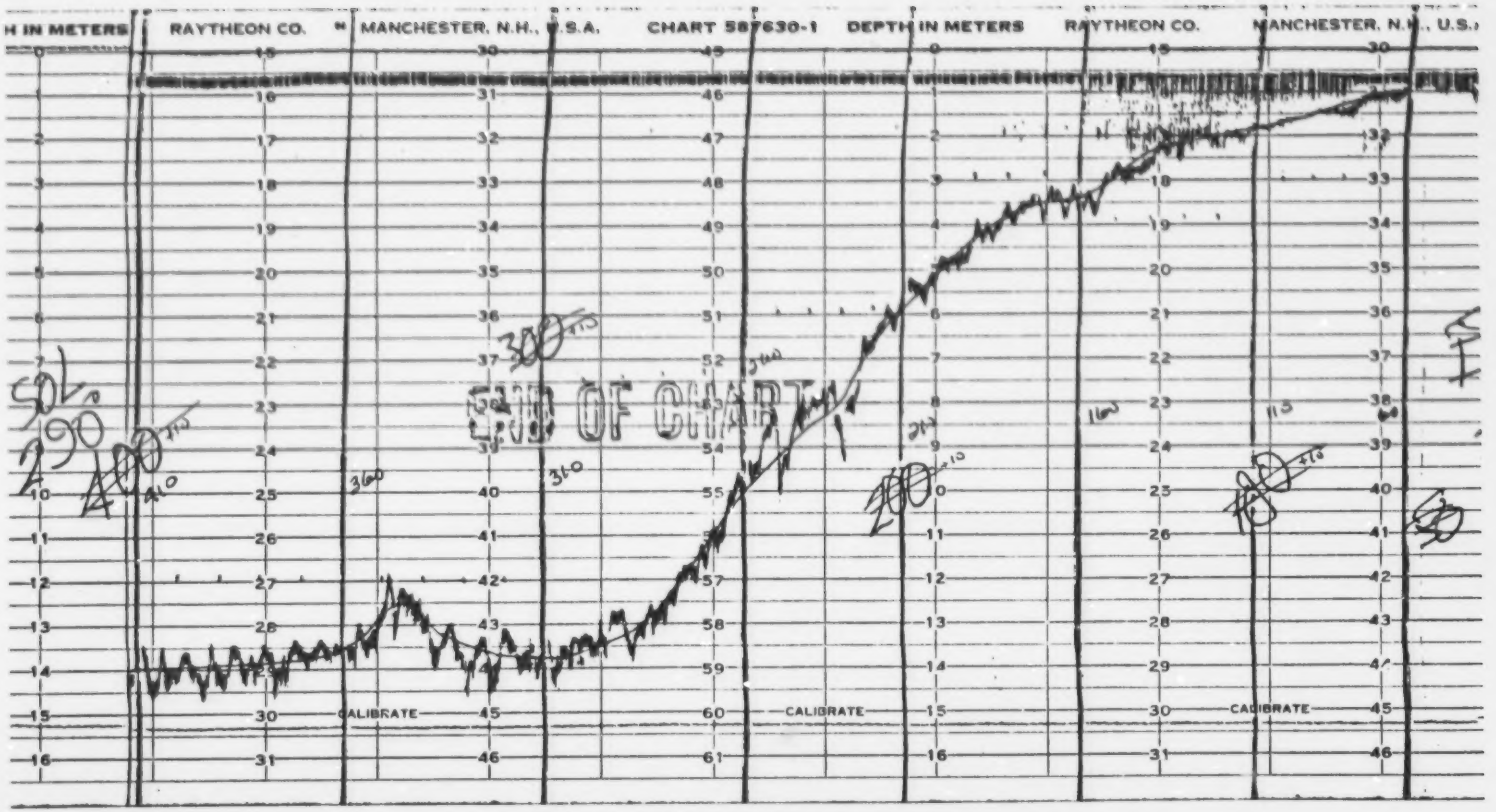
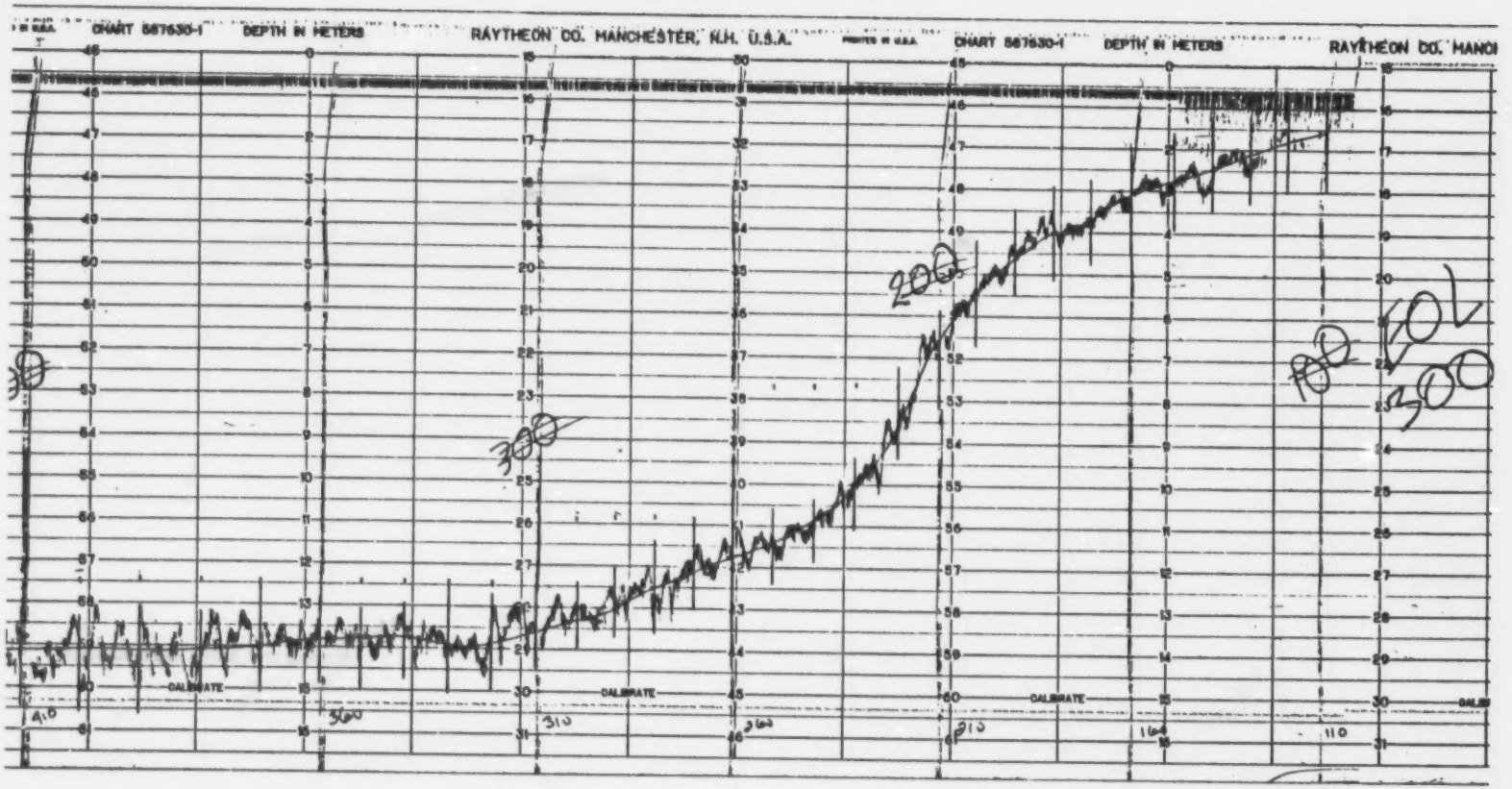
Date: 10/08/86



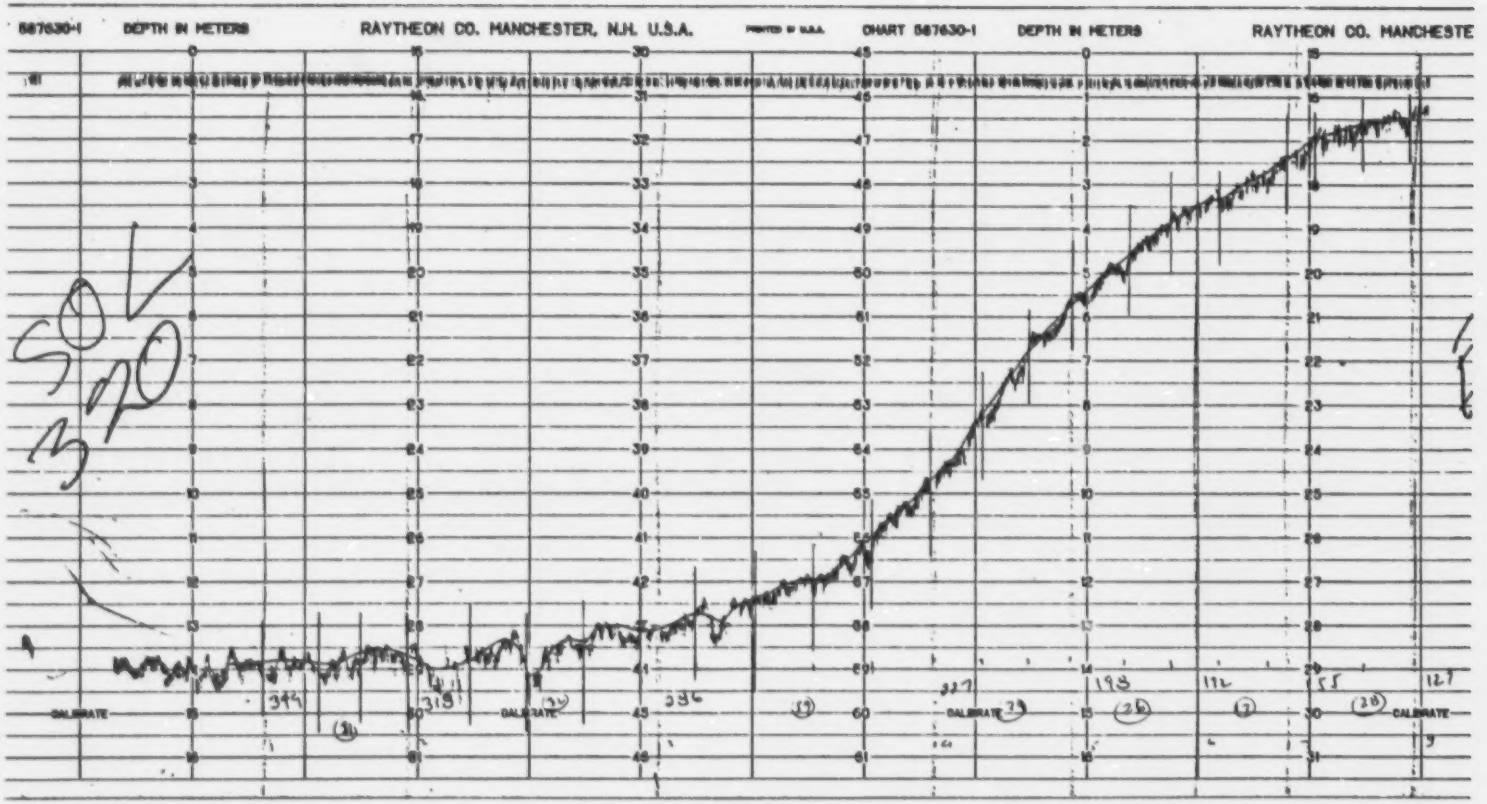
## ECHO SOUNDER RECORDING

Location: Itiyok Island
Profile: Line 300
Date: 10/08/86



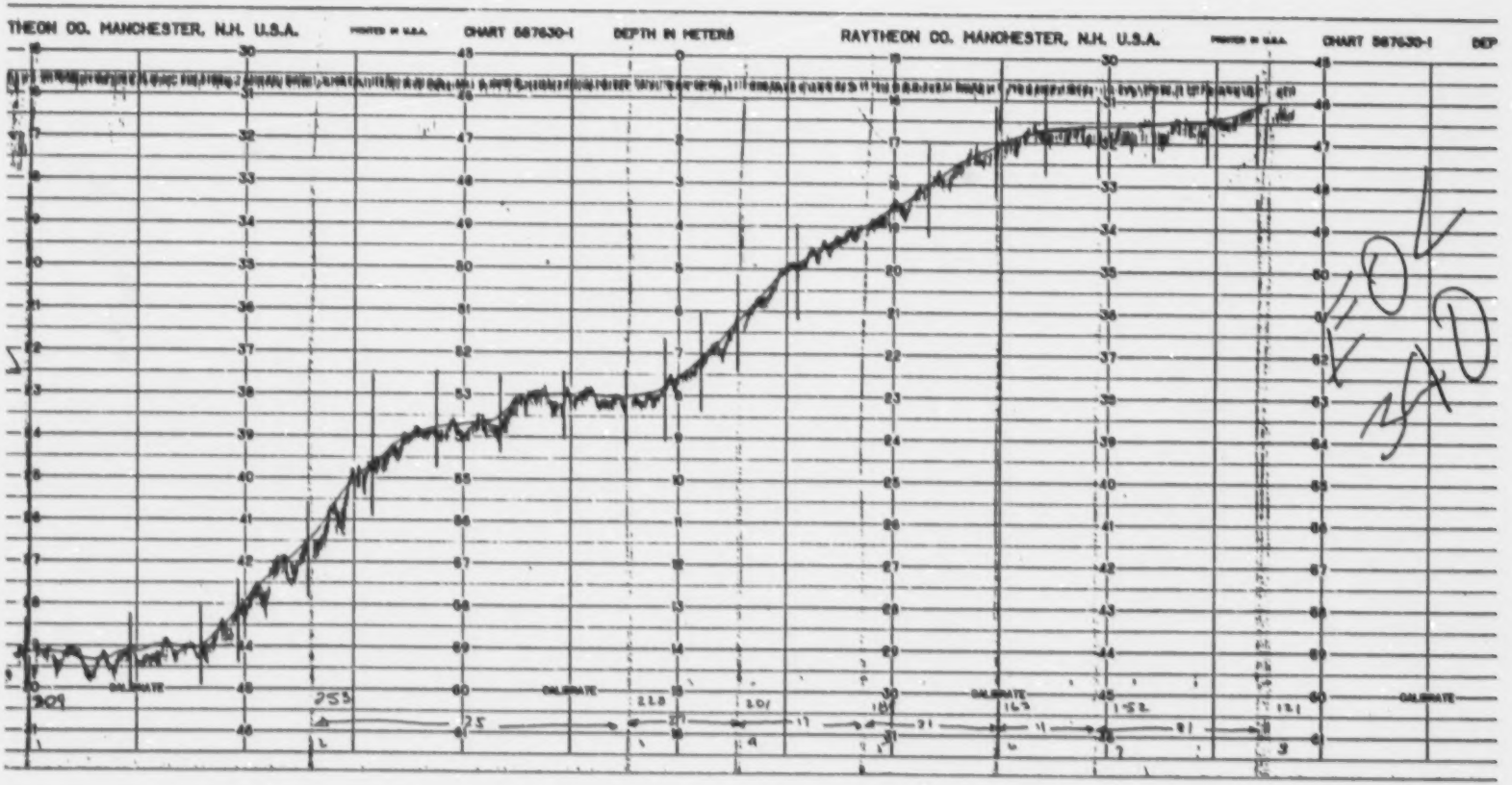
**ECHO SOUNDER RECORDING**

Location: Itiyok Island
Profile: Line 320
Date: 13/08/86

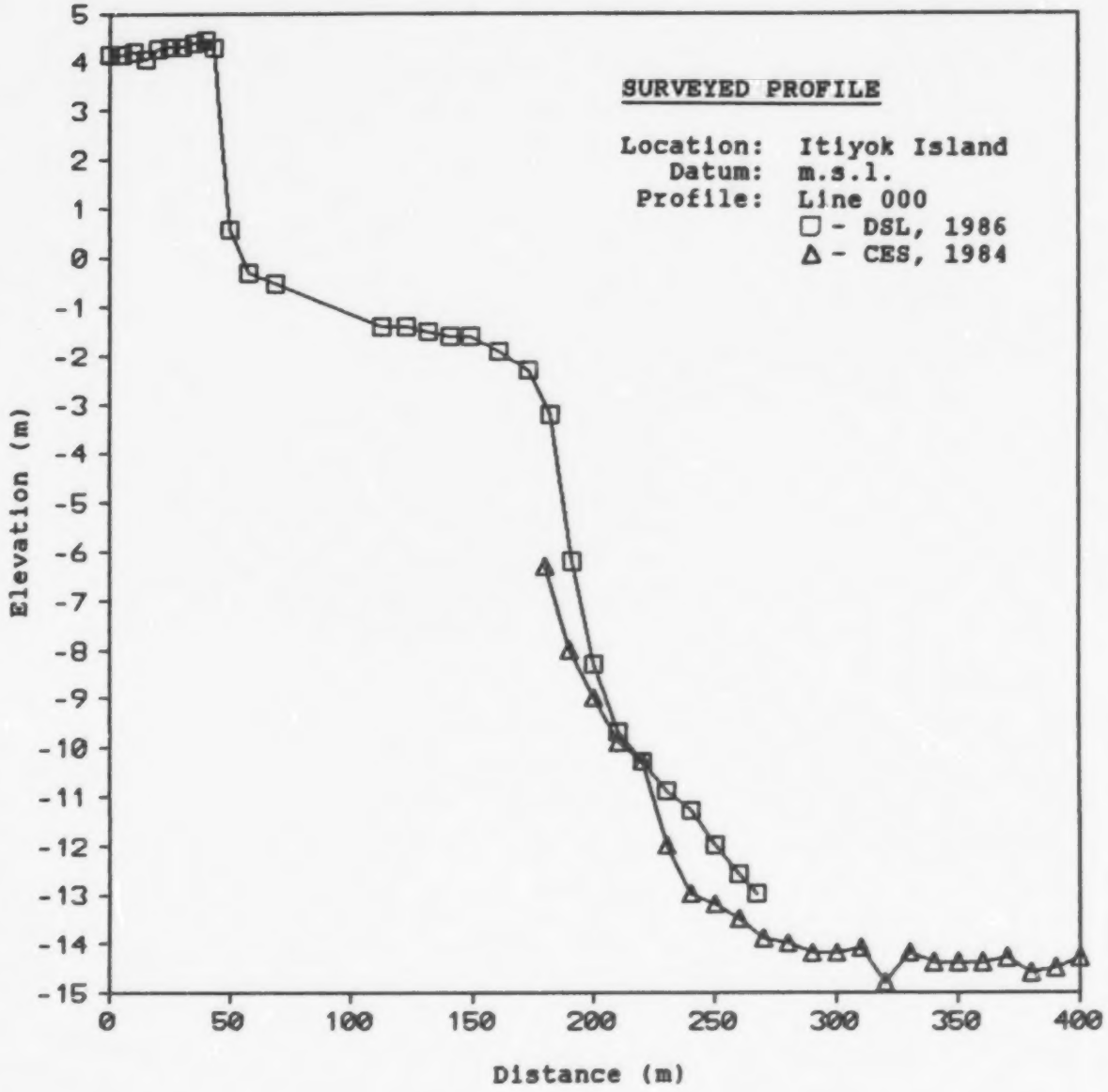


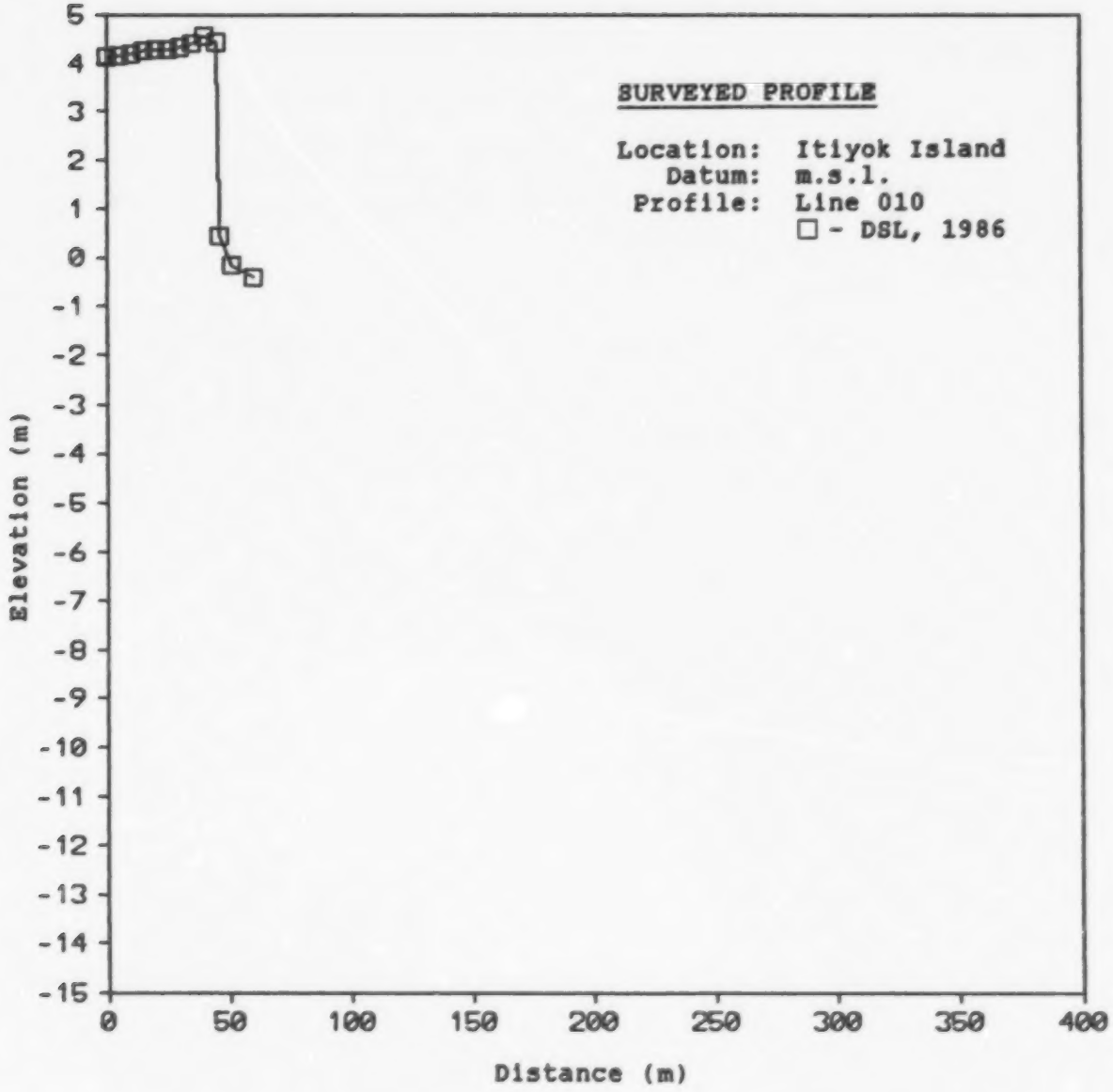
## ECHO SOUNDER RECORDING

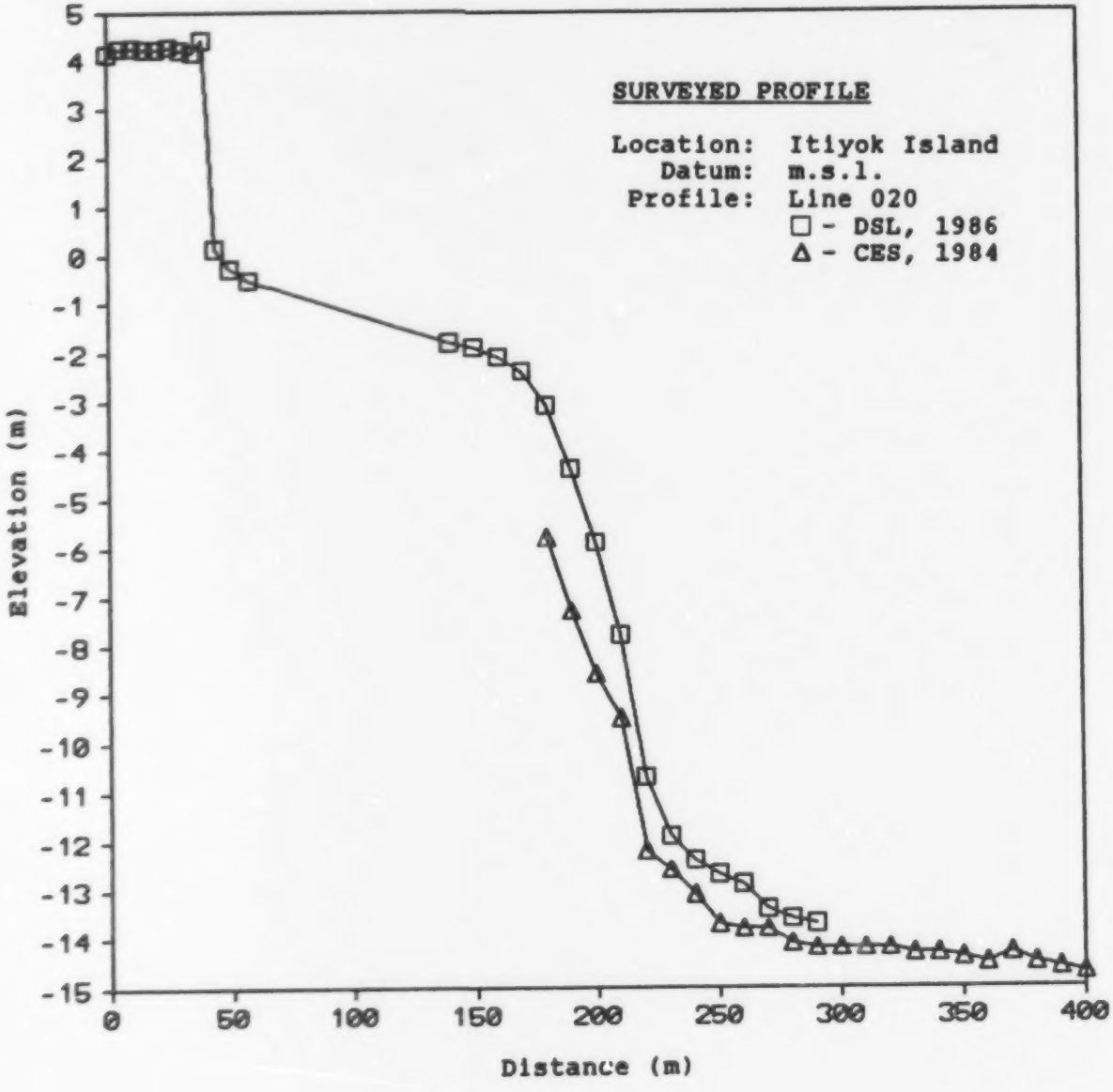
Location: Itiyok Island
Profile: Line 340
Date: 13/08/86

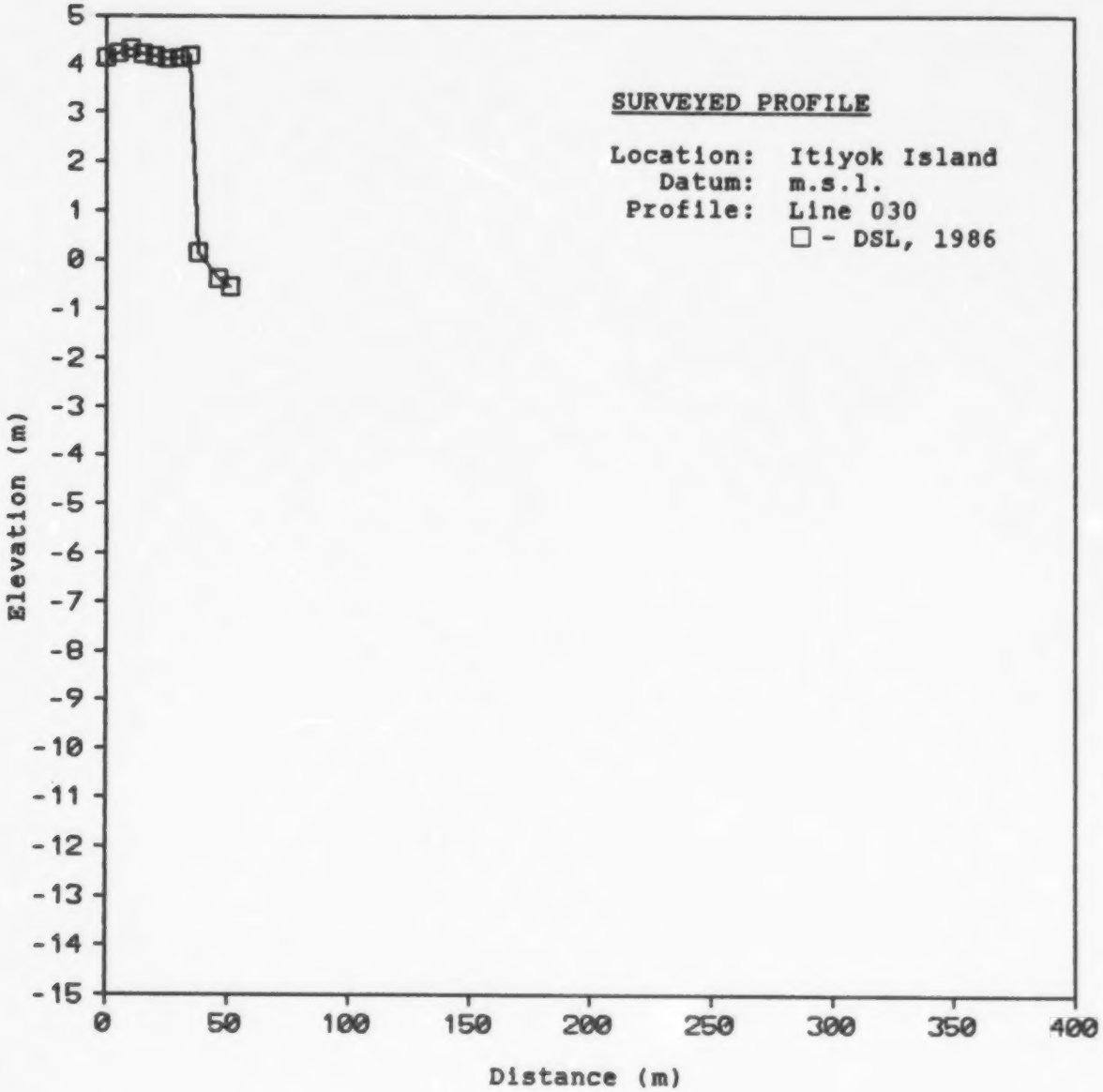


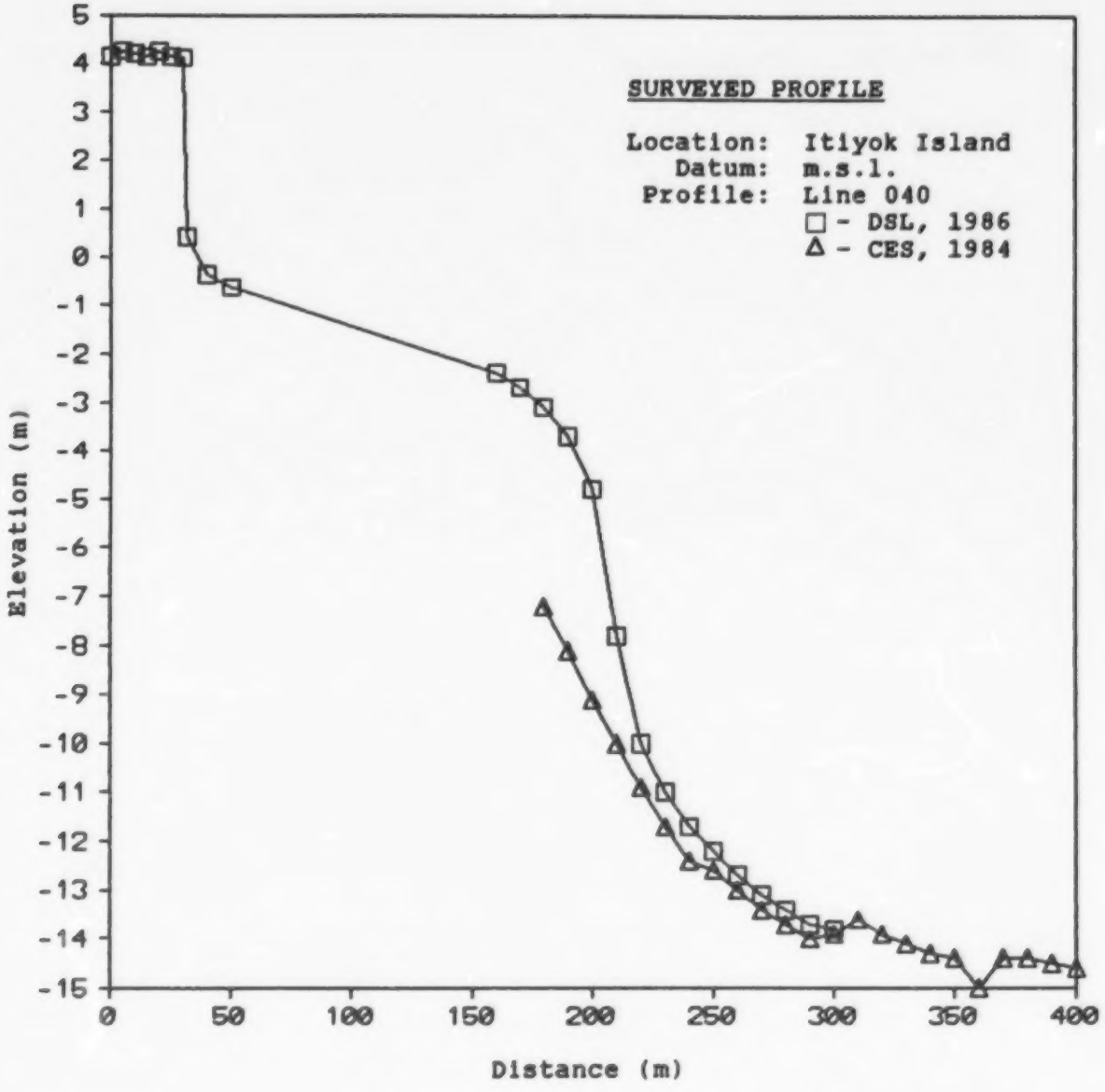
# PLOTS OF SURVEYED PROFILES

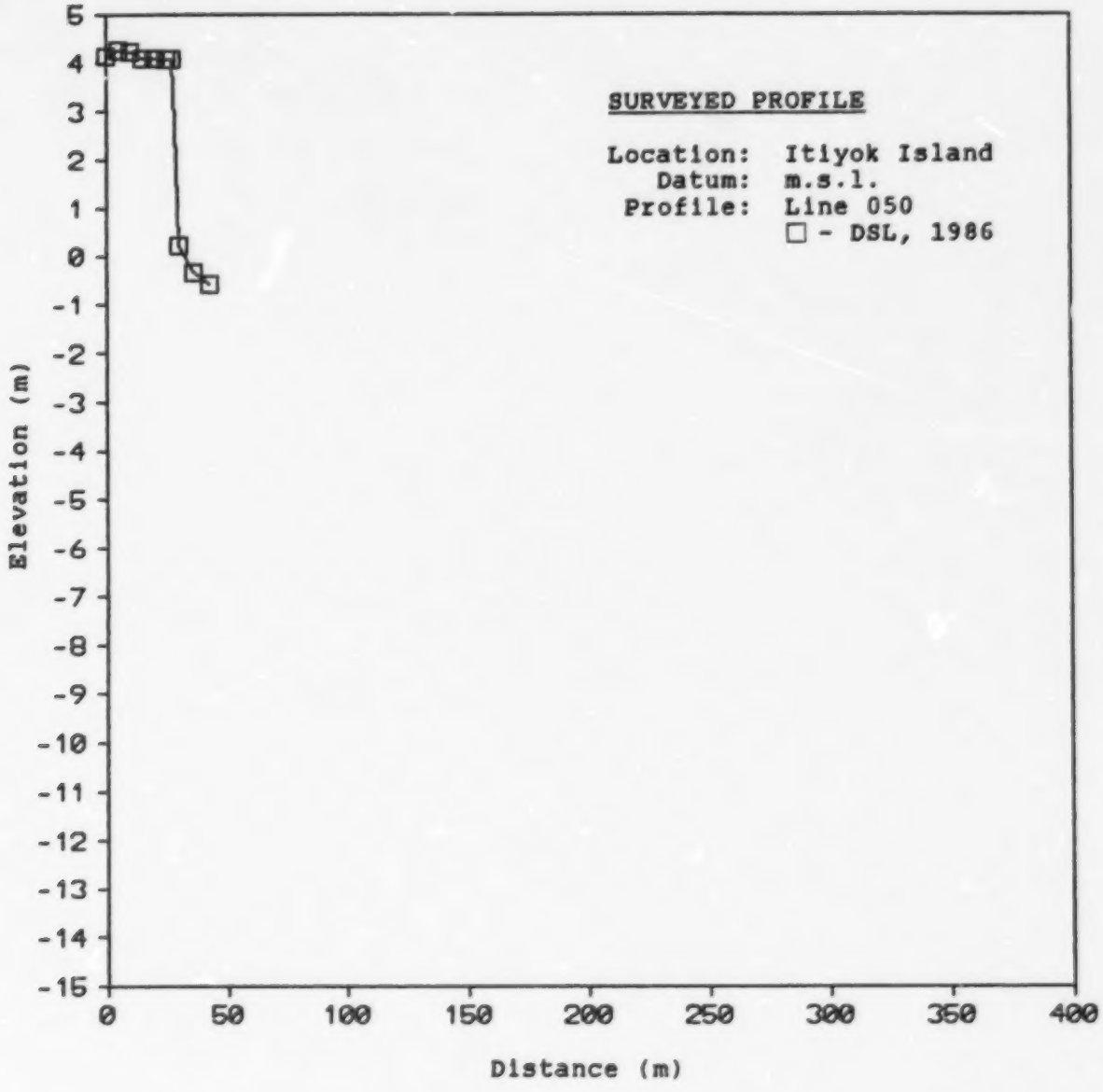

SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 000
□ - DSL, 1986
Δ - CES, 1984
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)

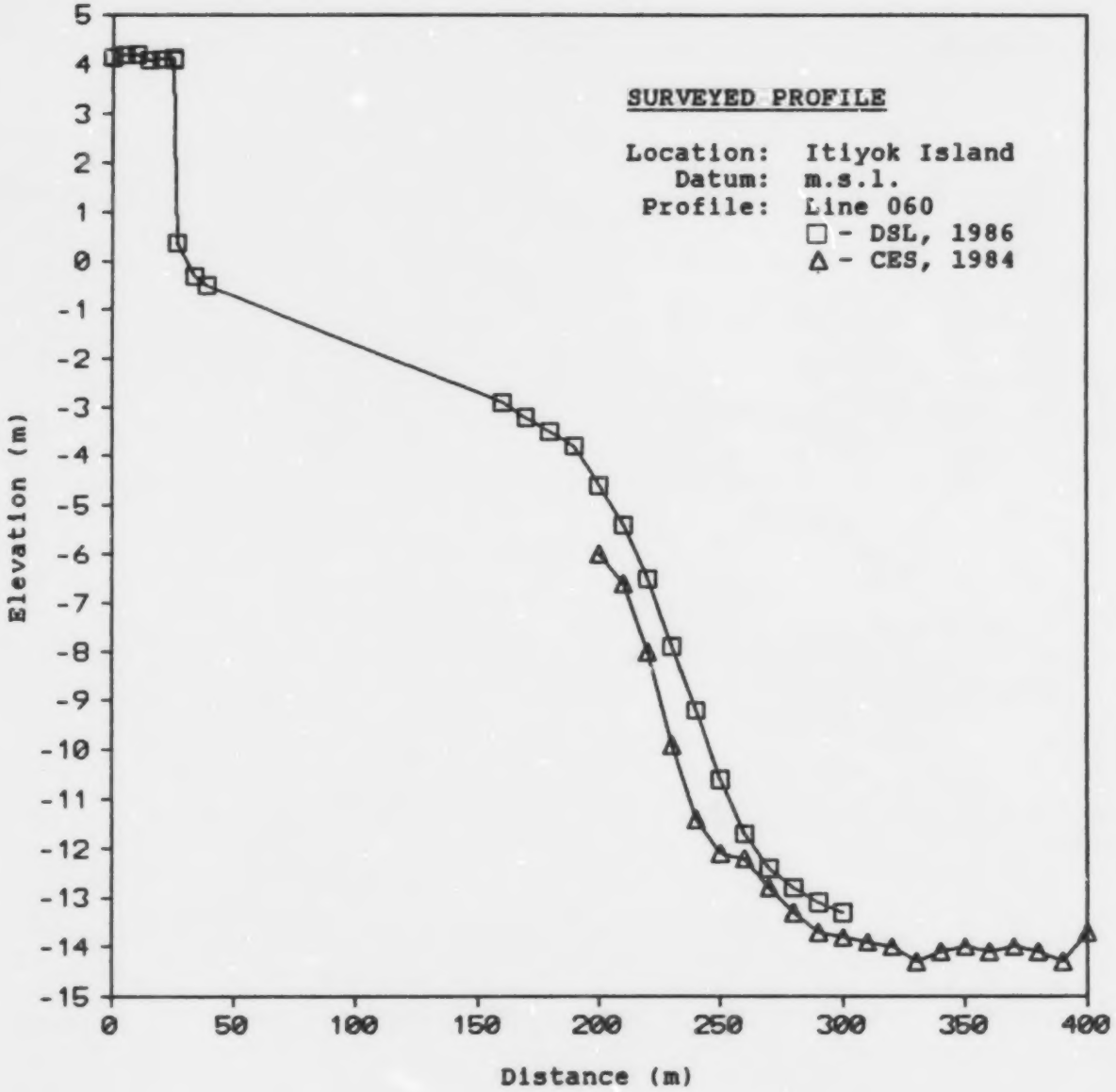

SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 010
□ - DSL, 1986
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)

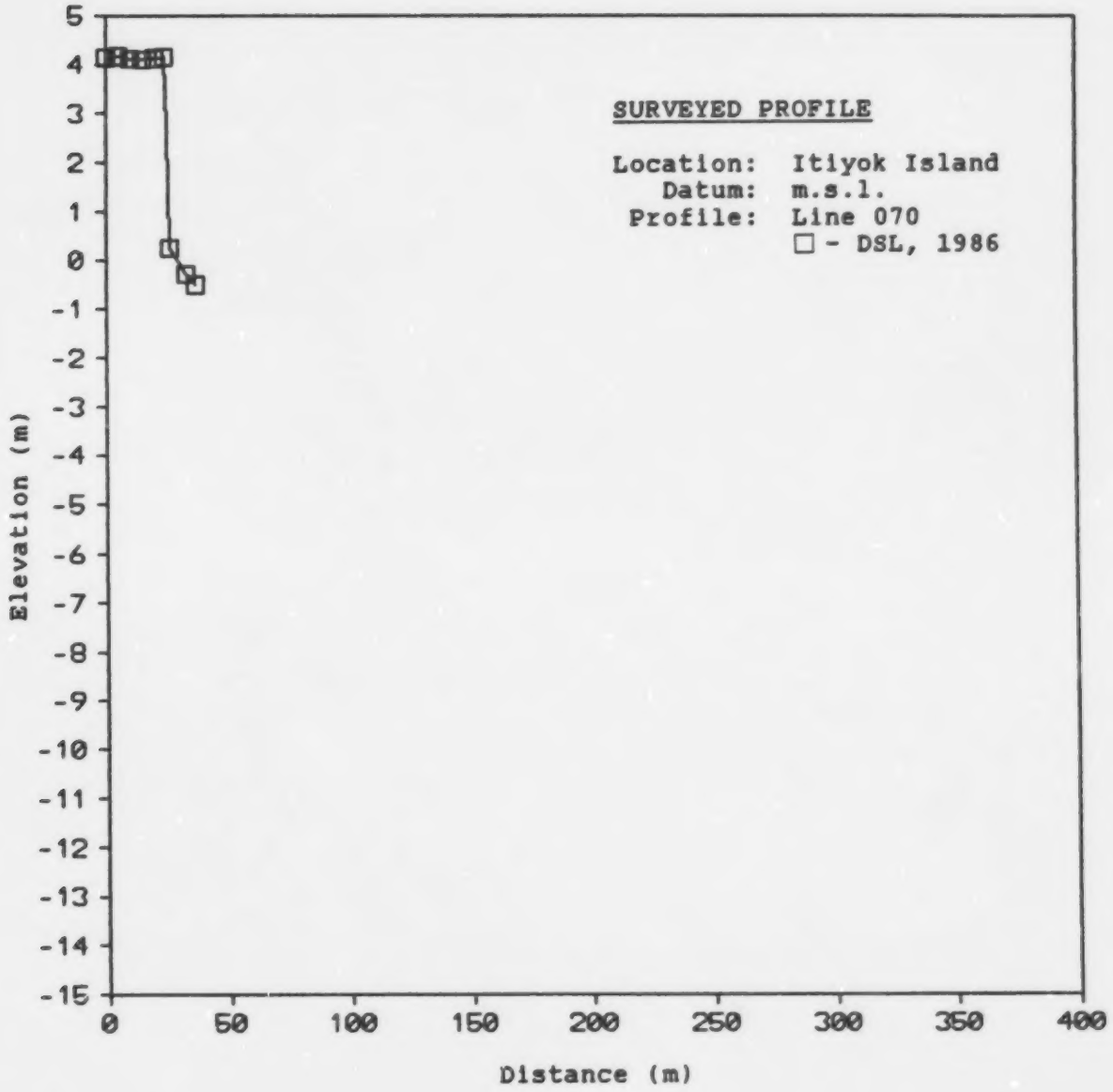

SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 020
□ - DSL, 1986
Δ - CES, 1984
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)

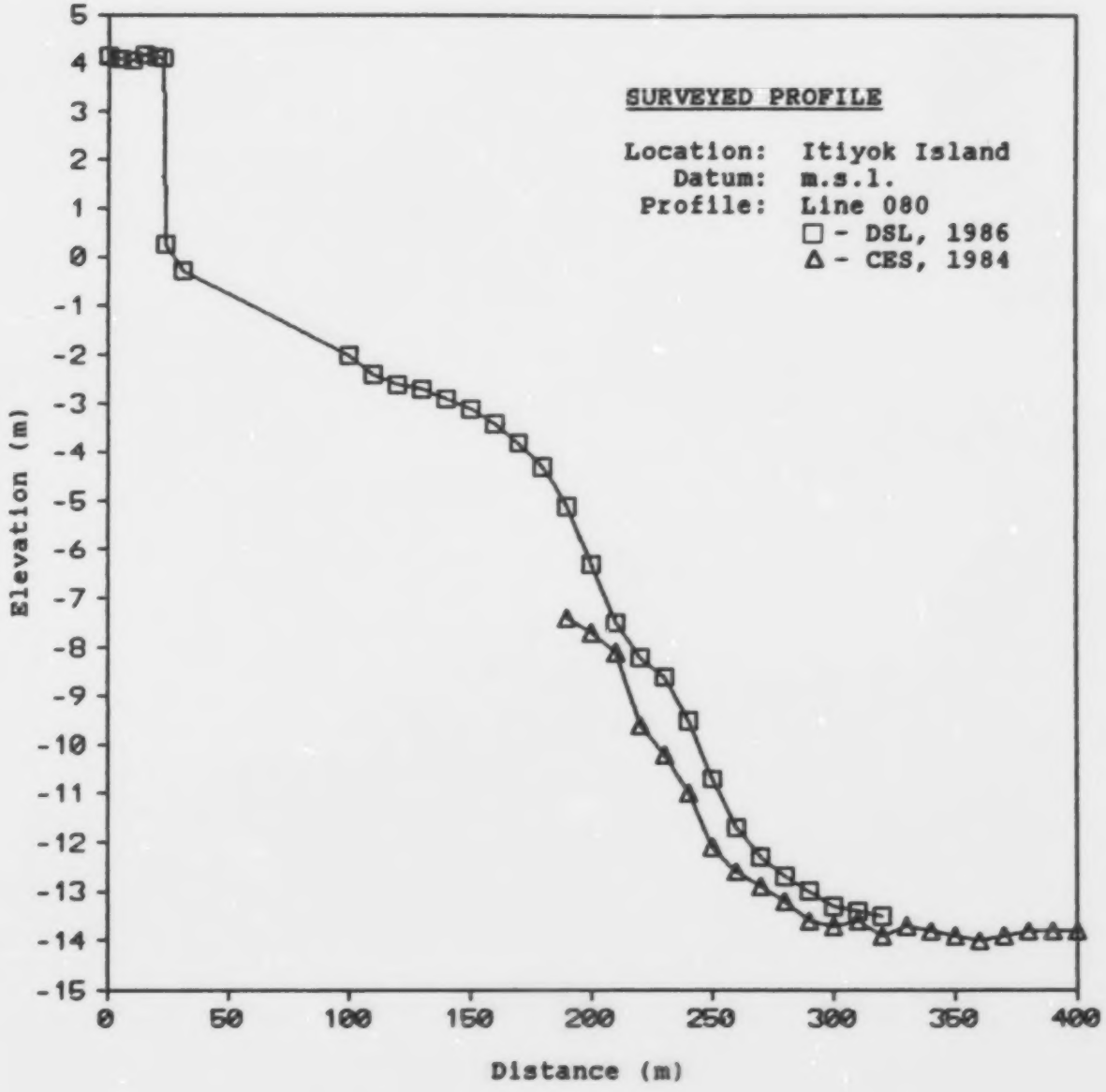

SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 030
□ - DSL, 1986
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)

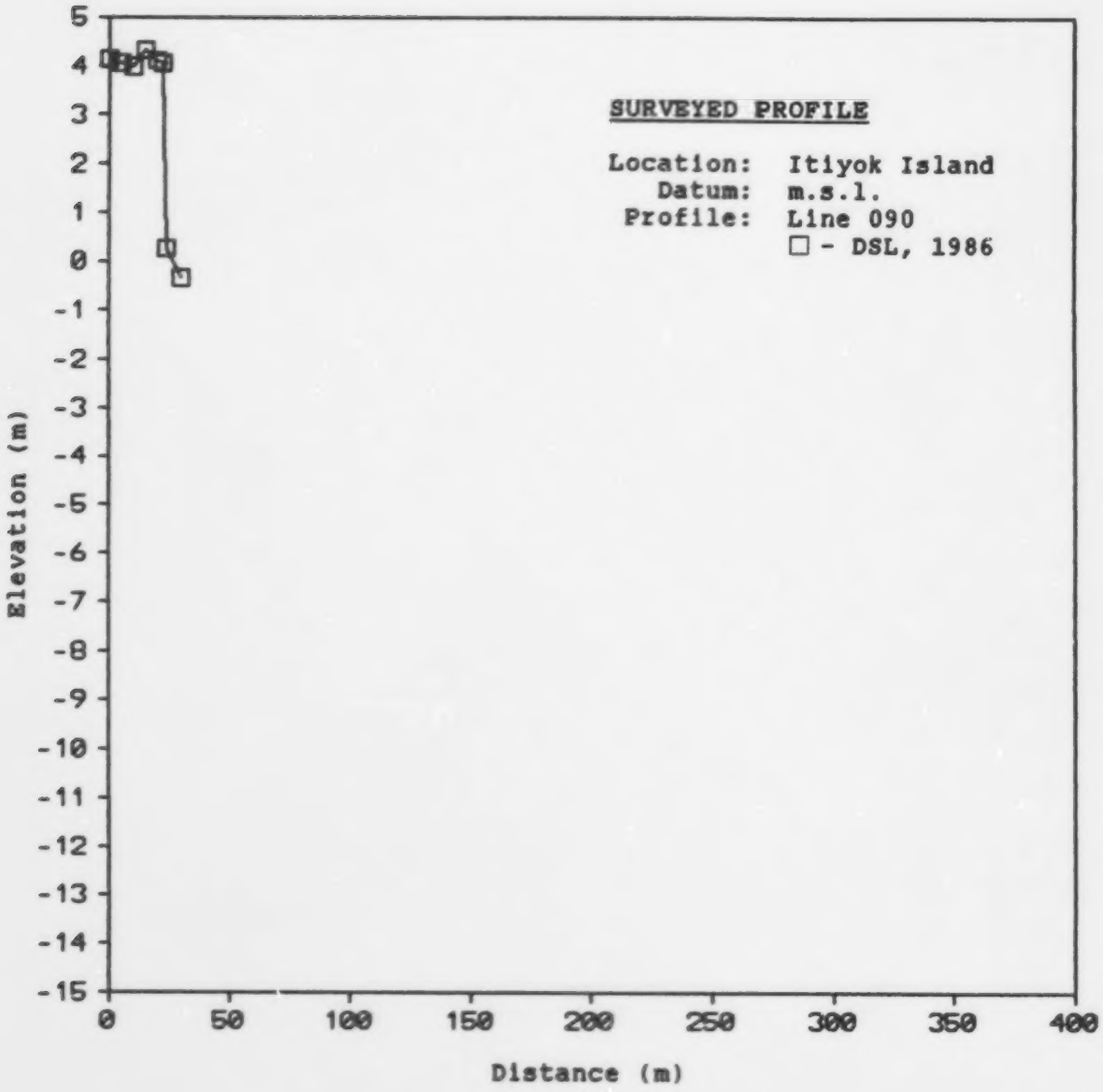

SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 040
□ - DSL, 1986
Δ - CES, 1984
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)


SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 050
□ - DSL, 1986
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)


SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 060
□ - DSL, 1986
Δ - CES, 1984
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)


SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 070
□ - DSL, 1986
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)


SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 080
□ - DSL, 1986
Δ - CES, 1984
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)


SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 090
□ - DSL, 1986
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
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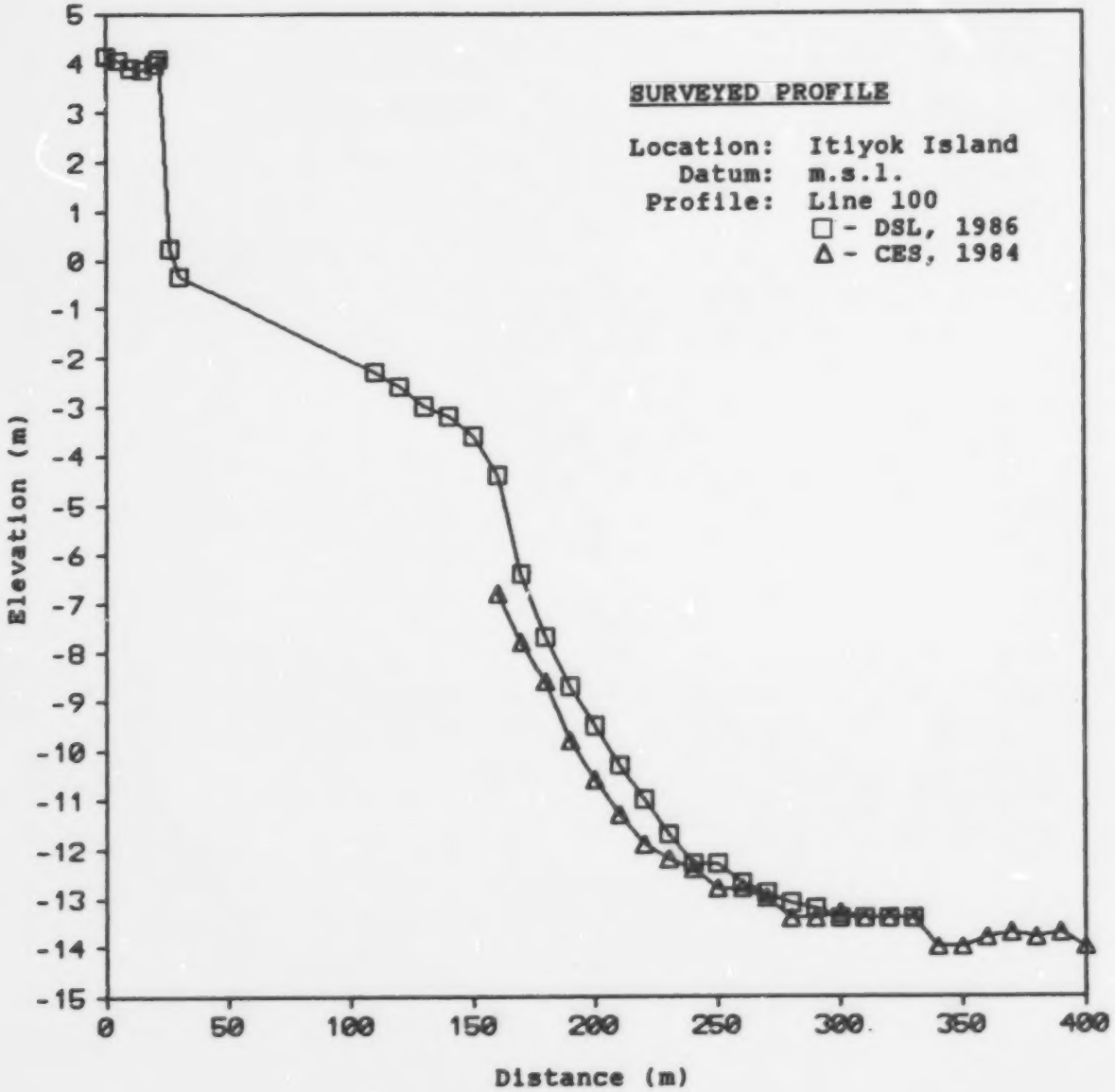
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)


SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 100
□ - DSL, 1986
Δ - CES, 1984
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
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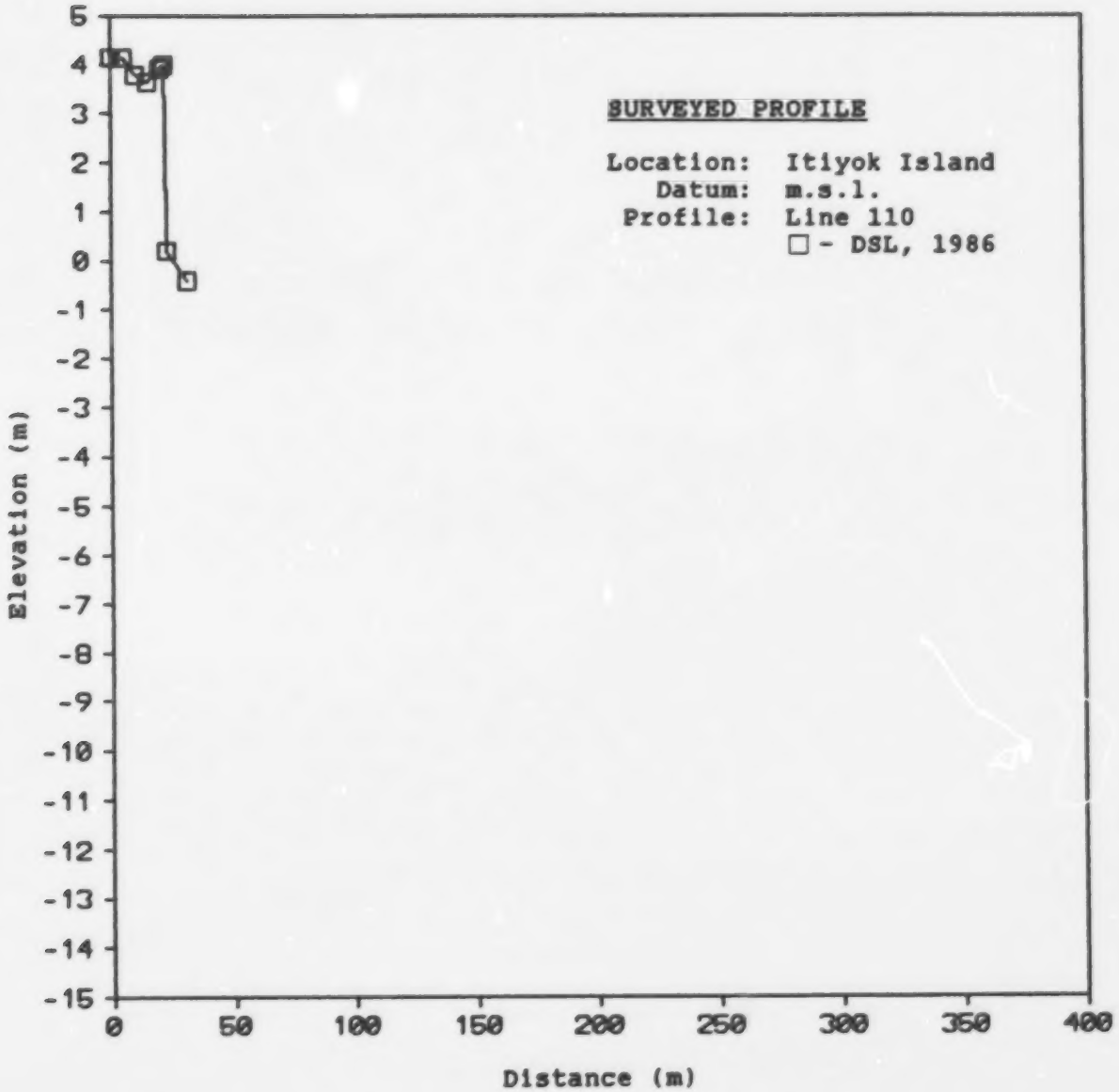
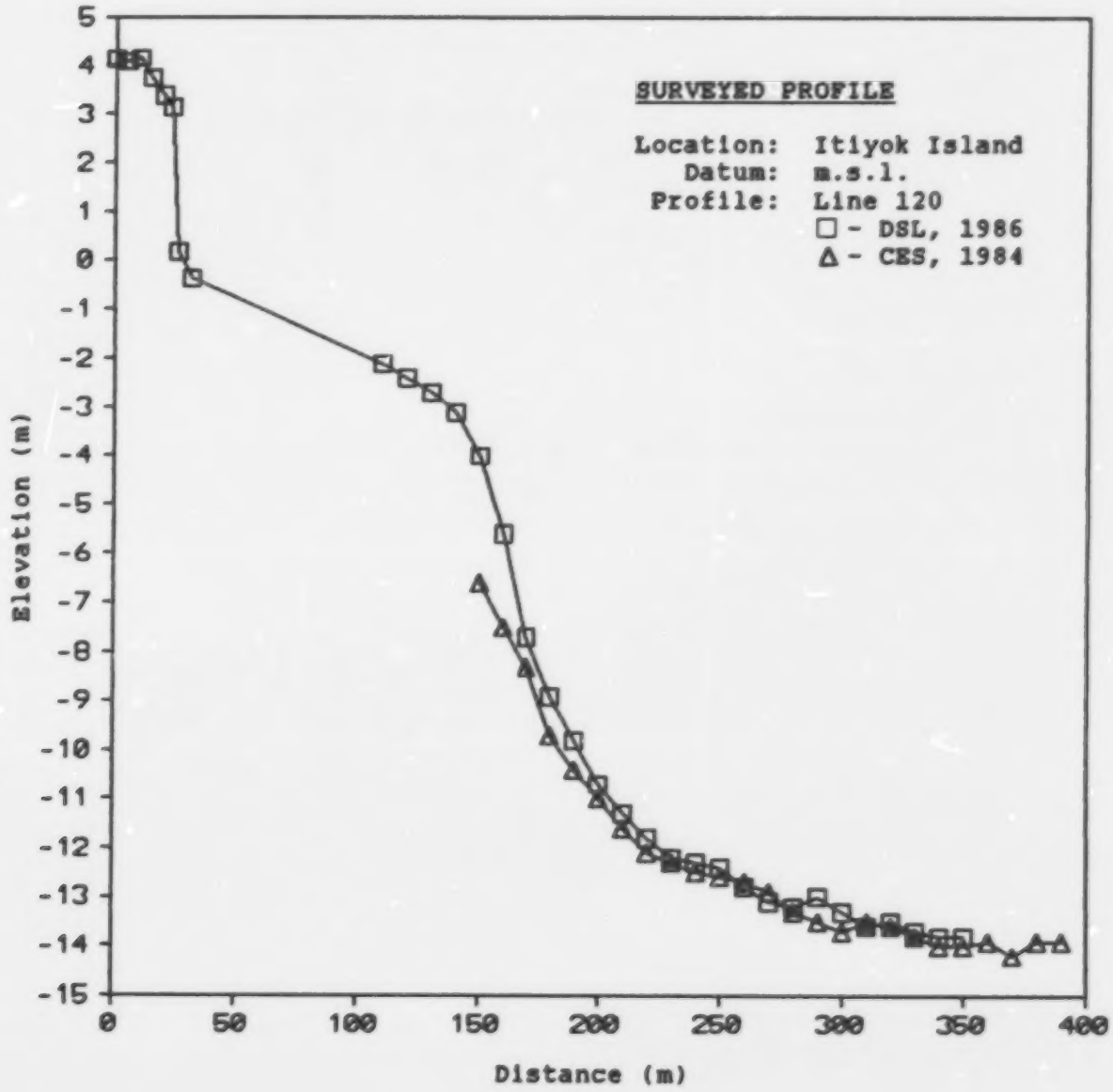
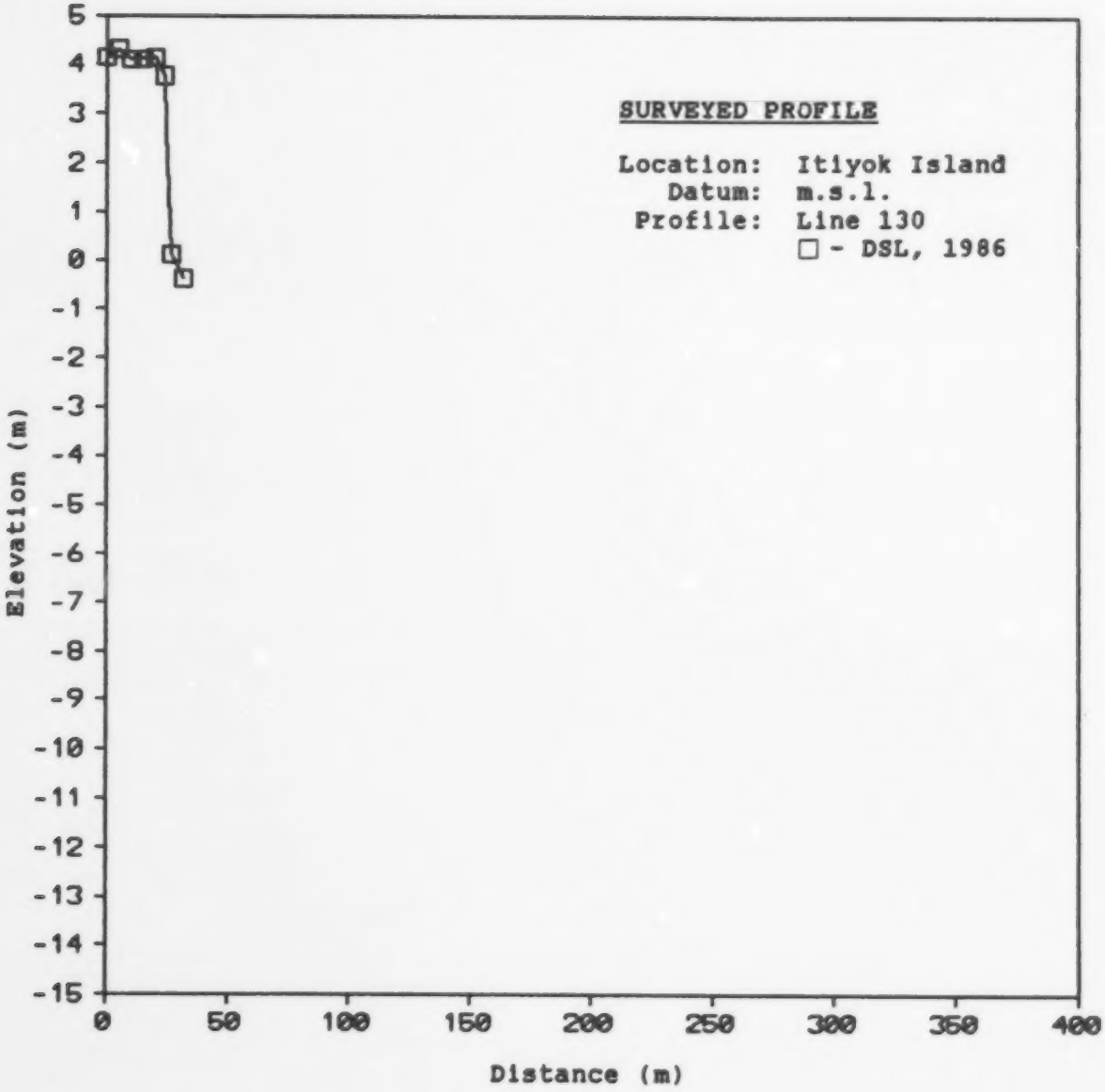
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)


SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 110
□ - DSL, 1986
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)


SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 120
□ - DSL, 1986
Δ - CES, 1984
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)


SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 130
□ - DSL, 1986
Elevation (m)
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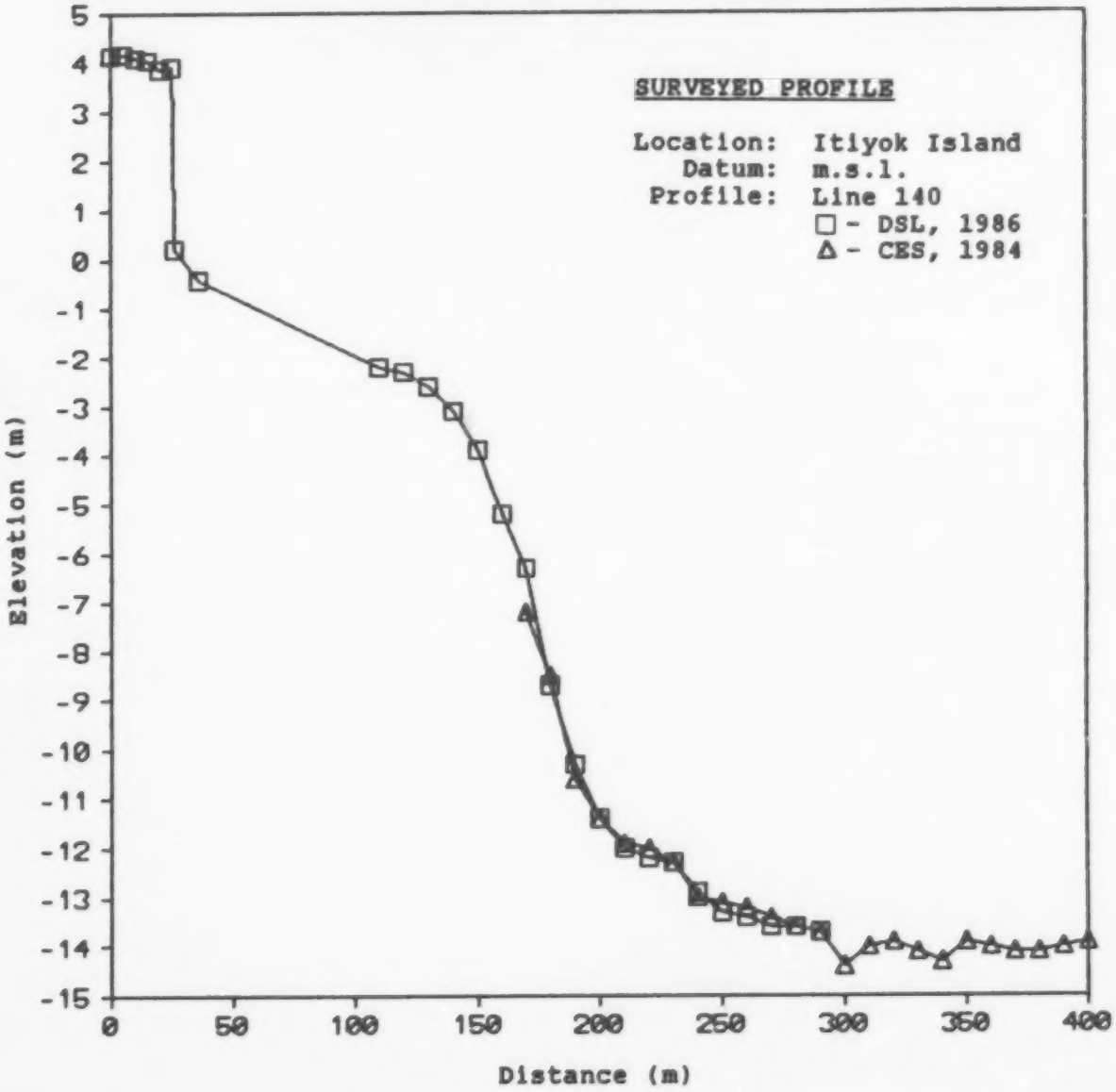
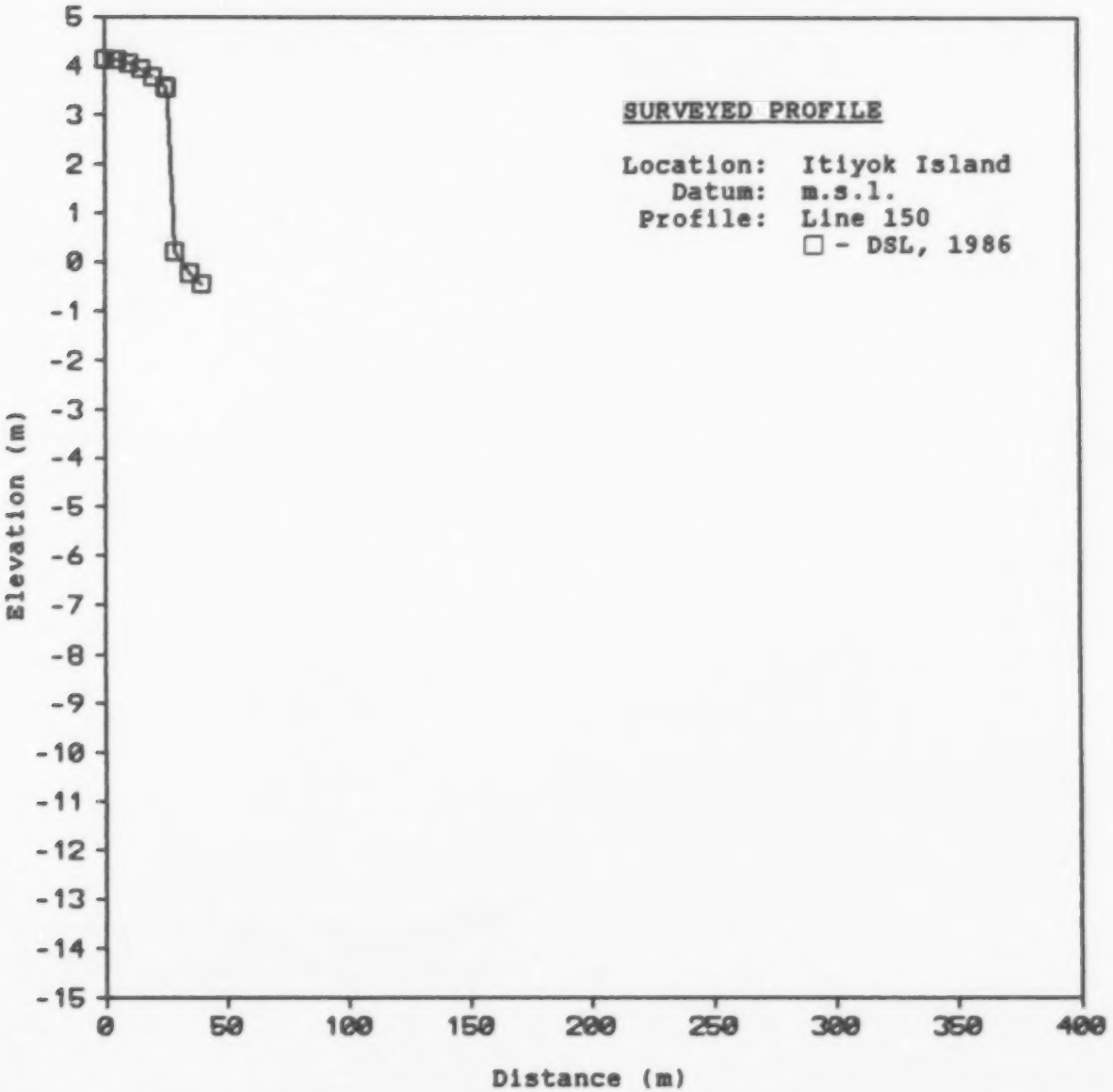
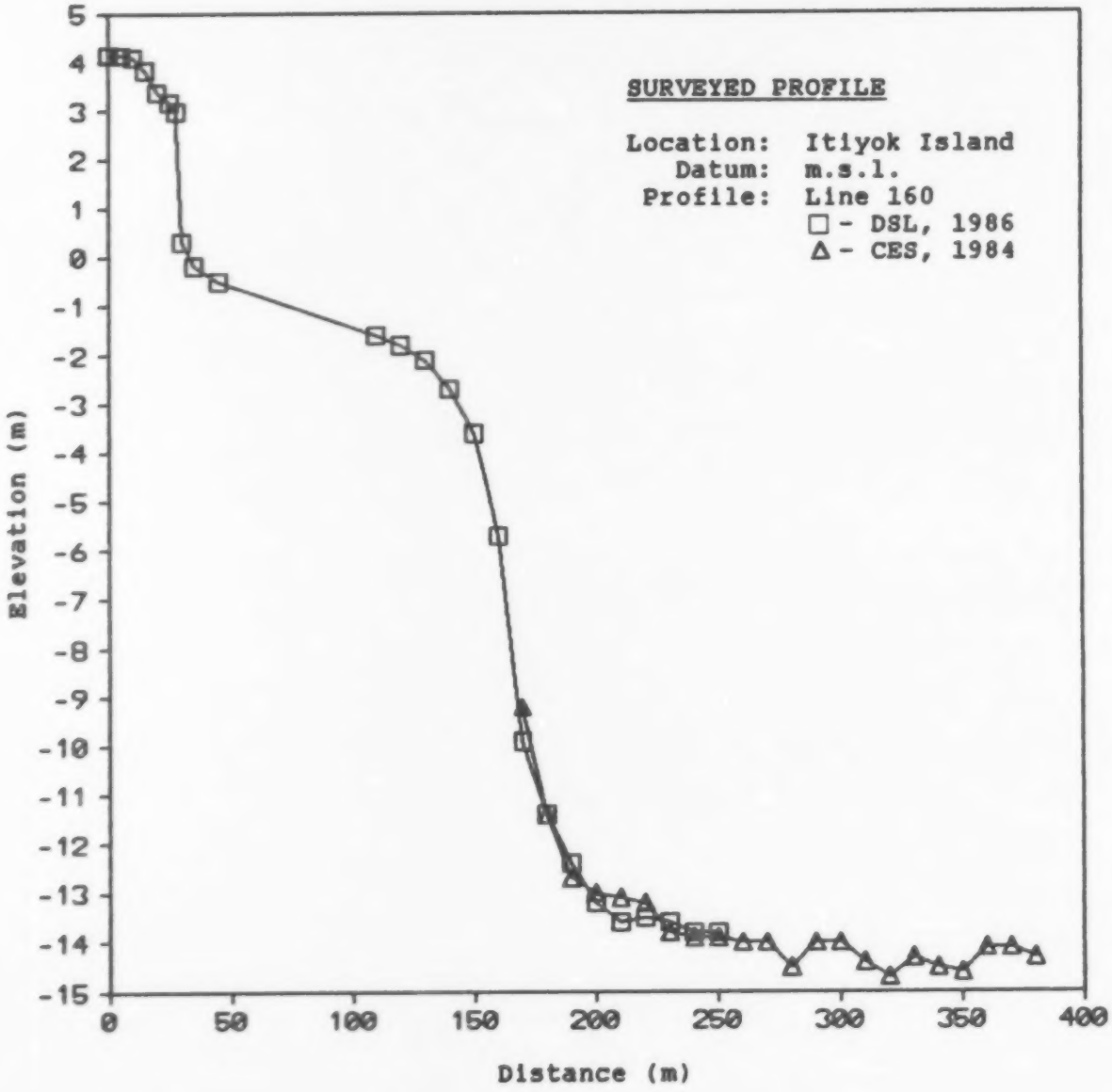
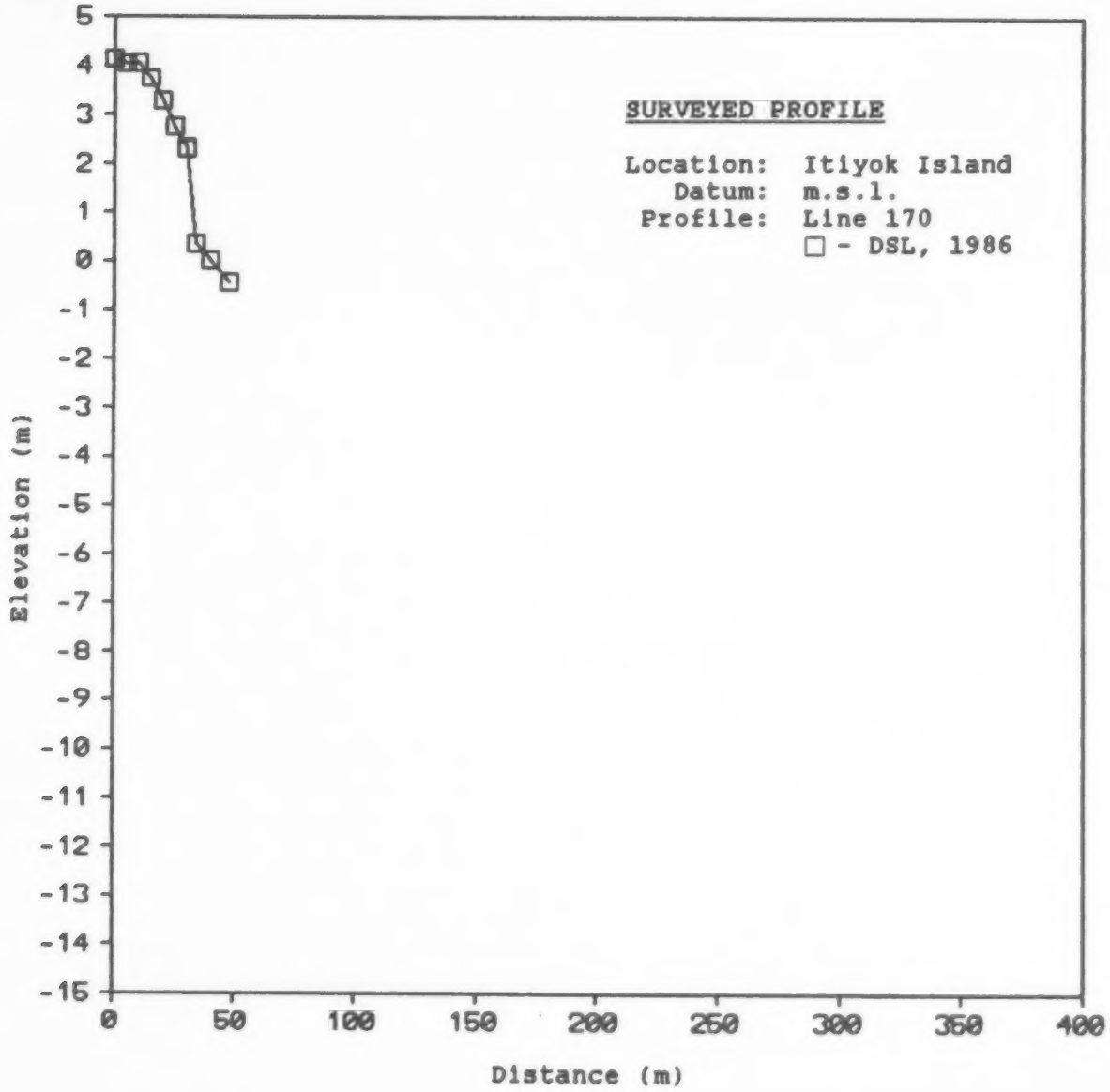
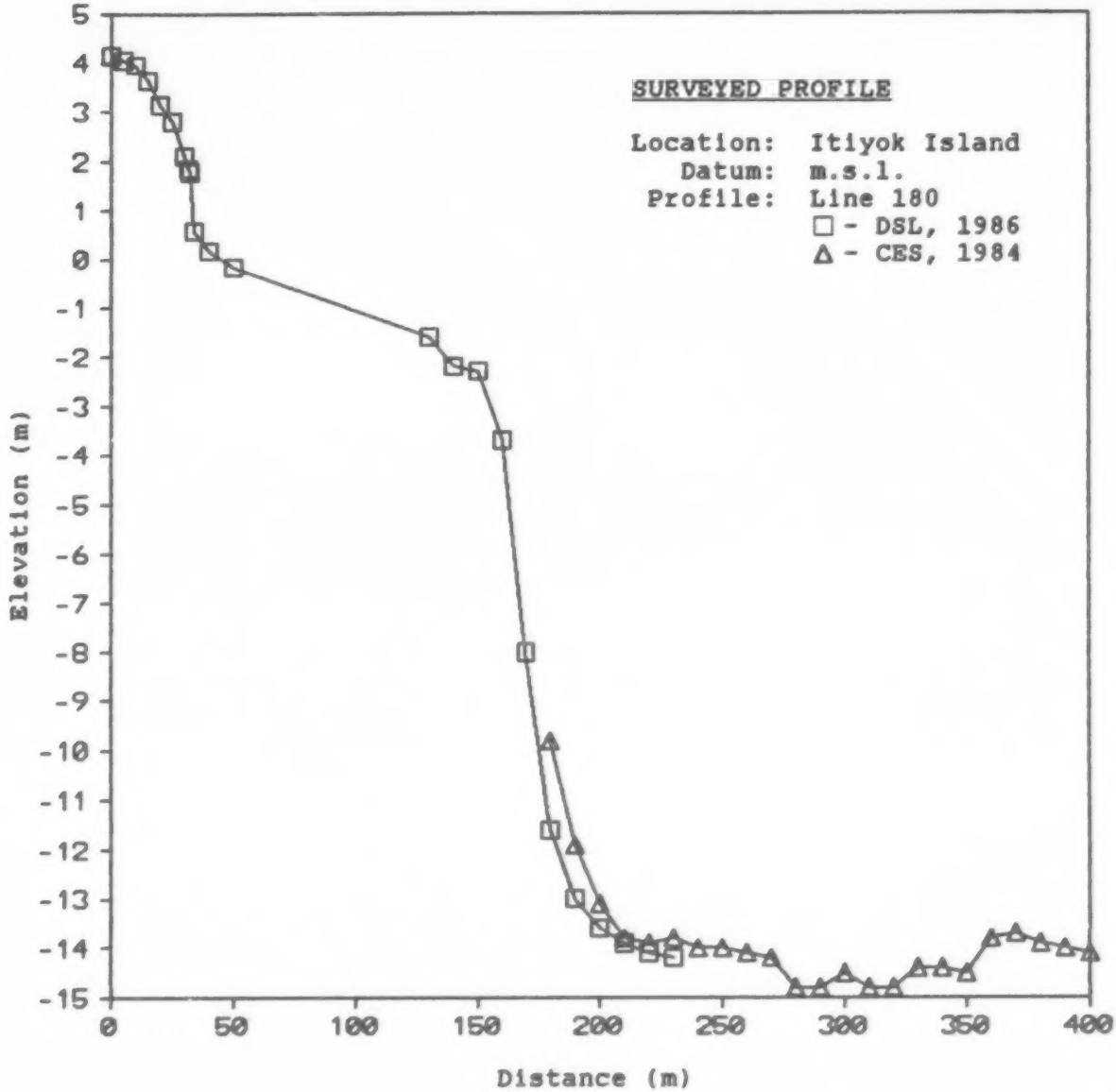
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)

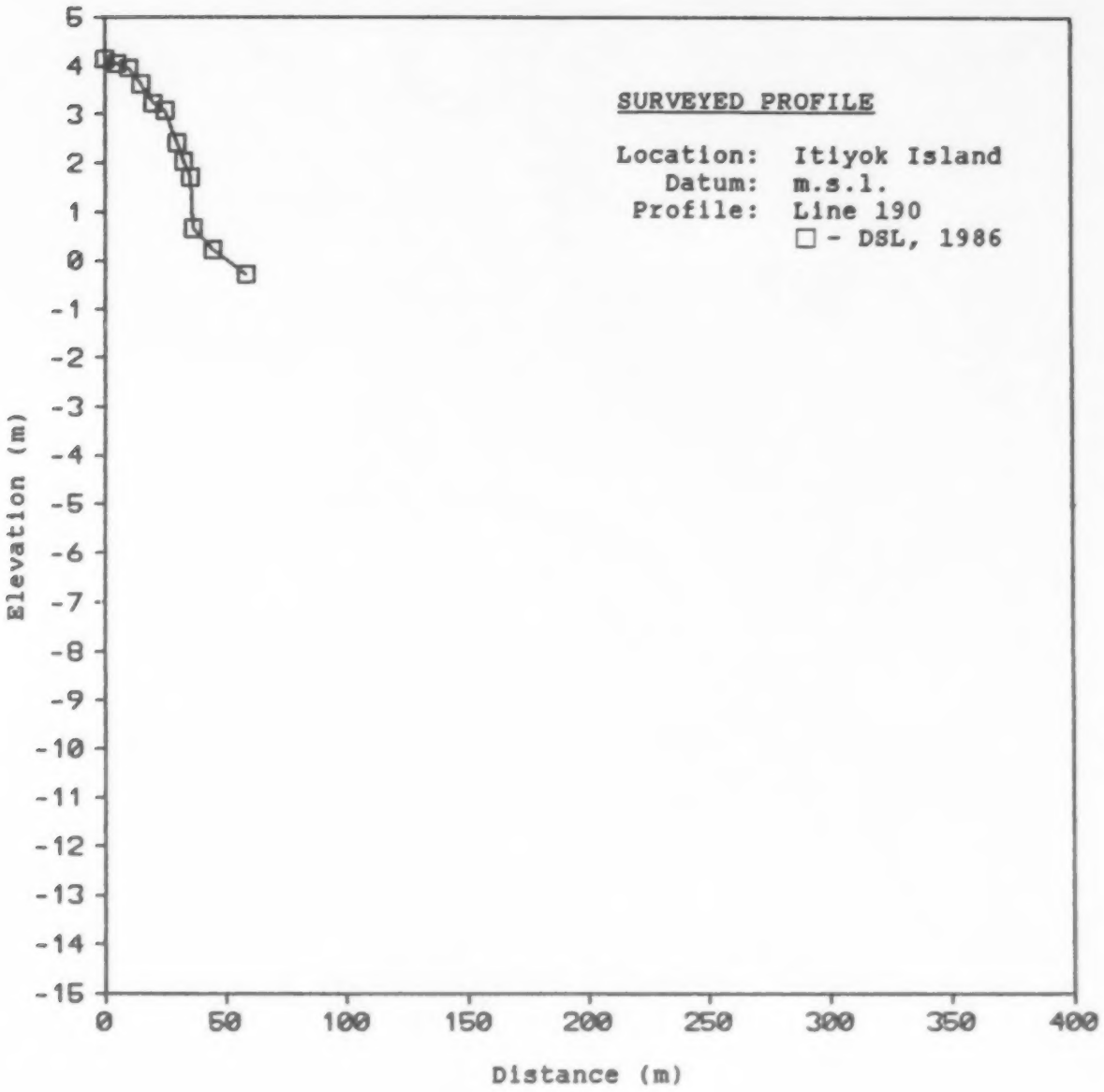

SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 140
□ - DSL, 1986
Δ - CES, 1984
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)

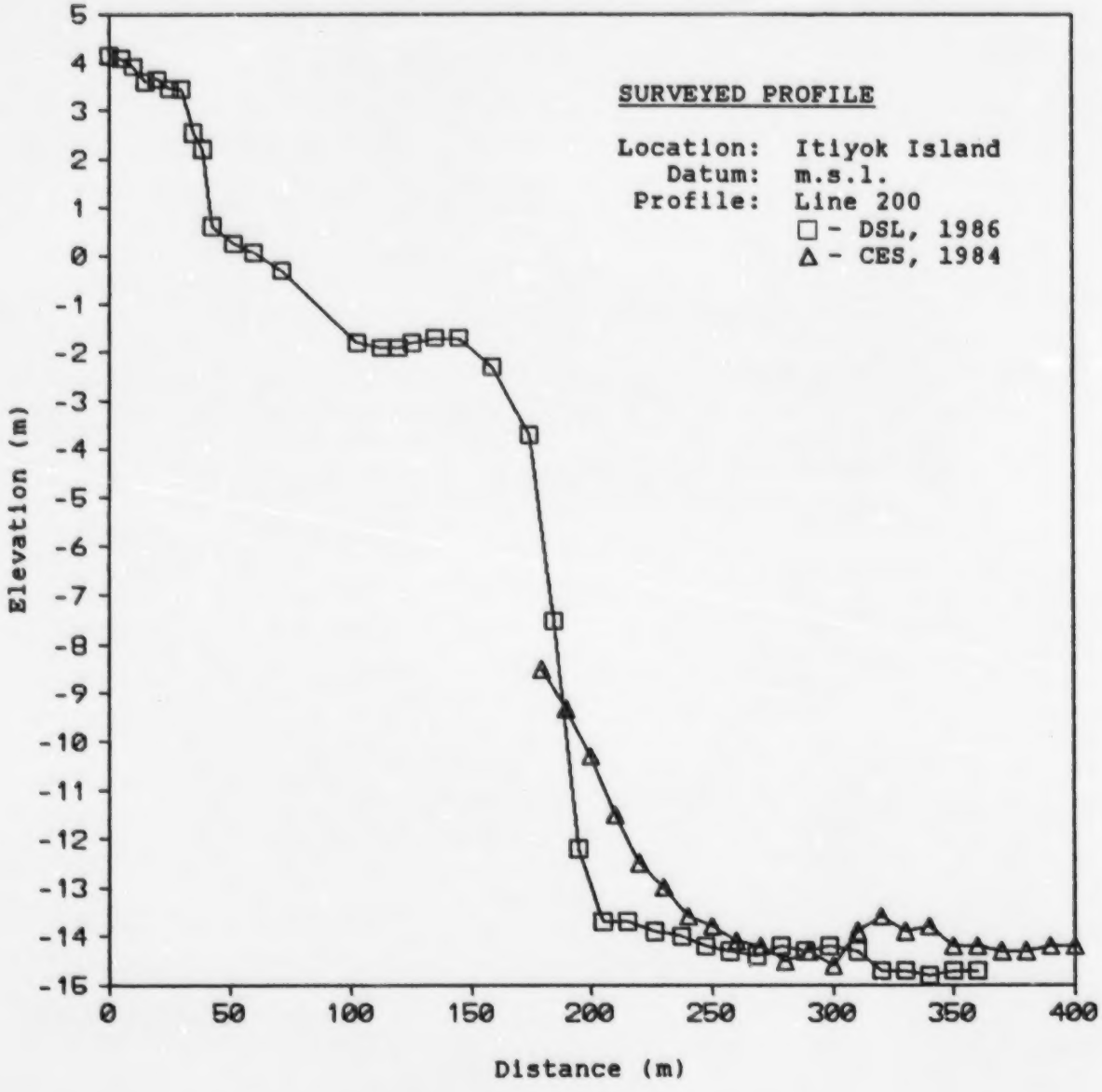

SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 150
□ - DSL, 1986
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)

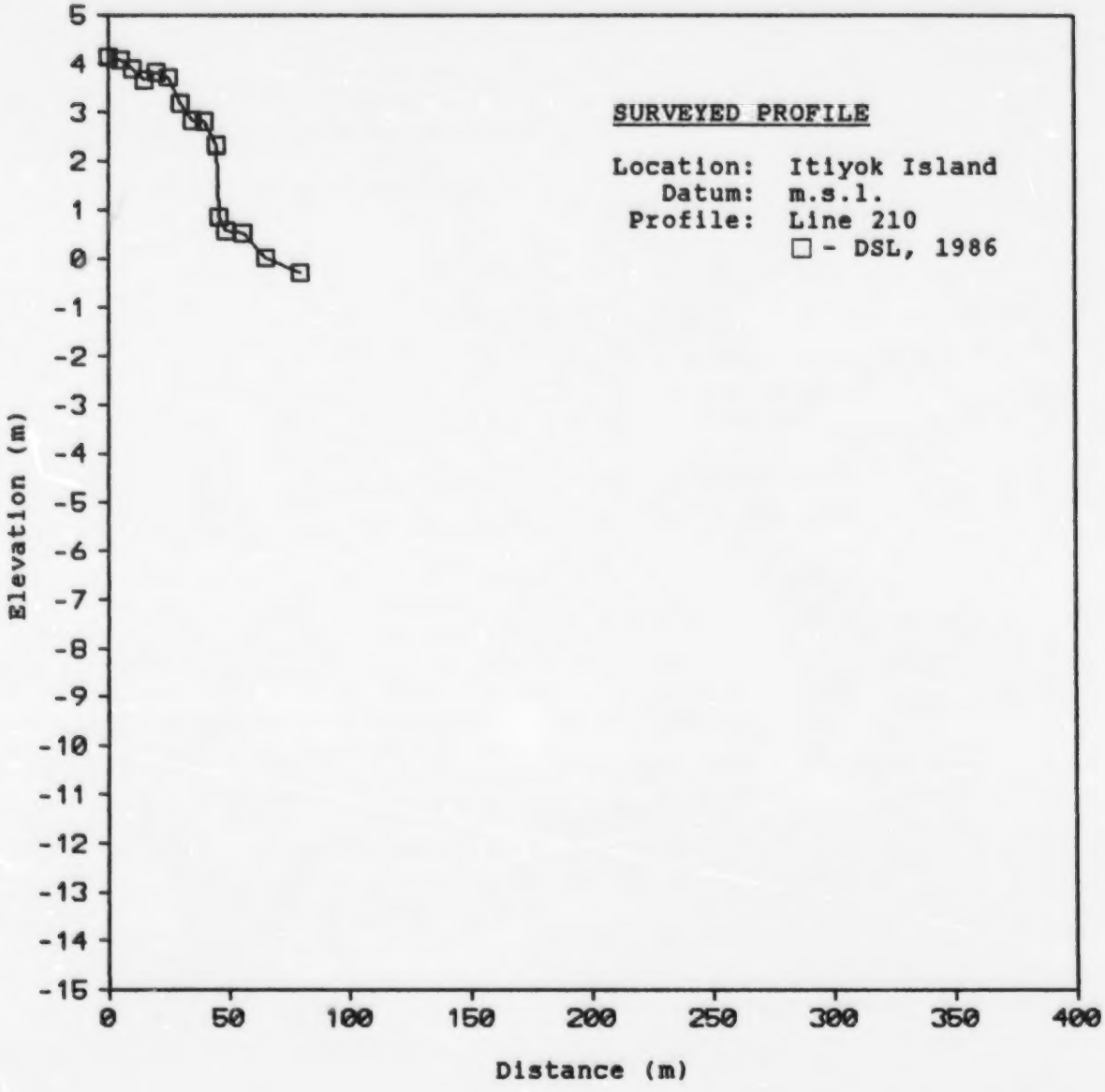

SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 160
□ - DSL, 1986
Δ - CES, 1984
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)

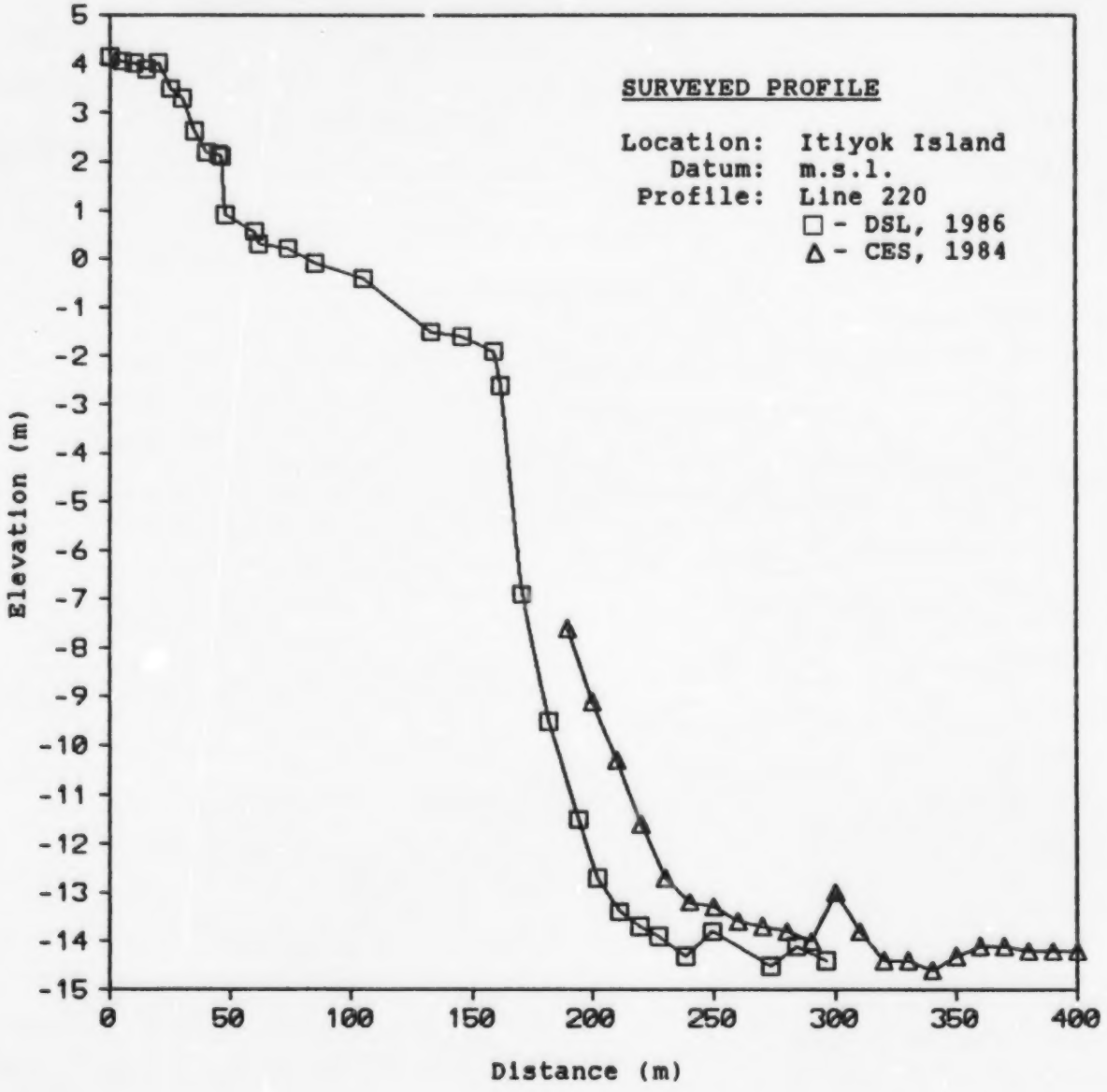

SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 170
□ - DSL, 1986
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)

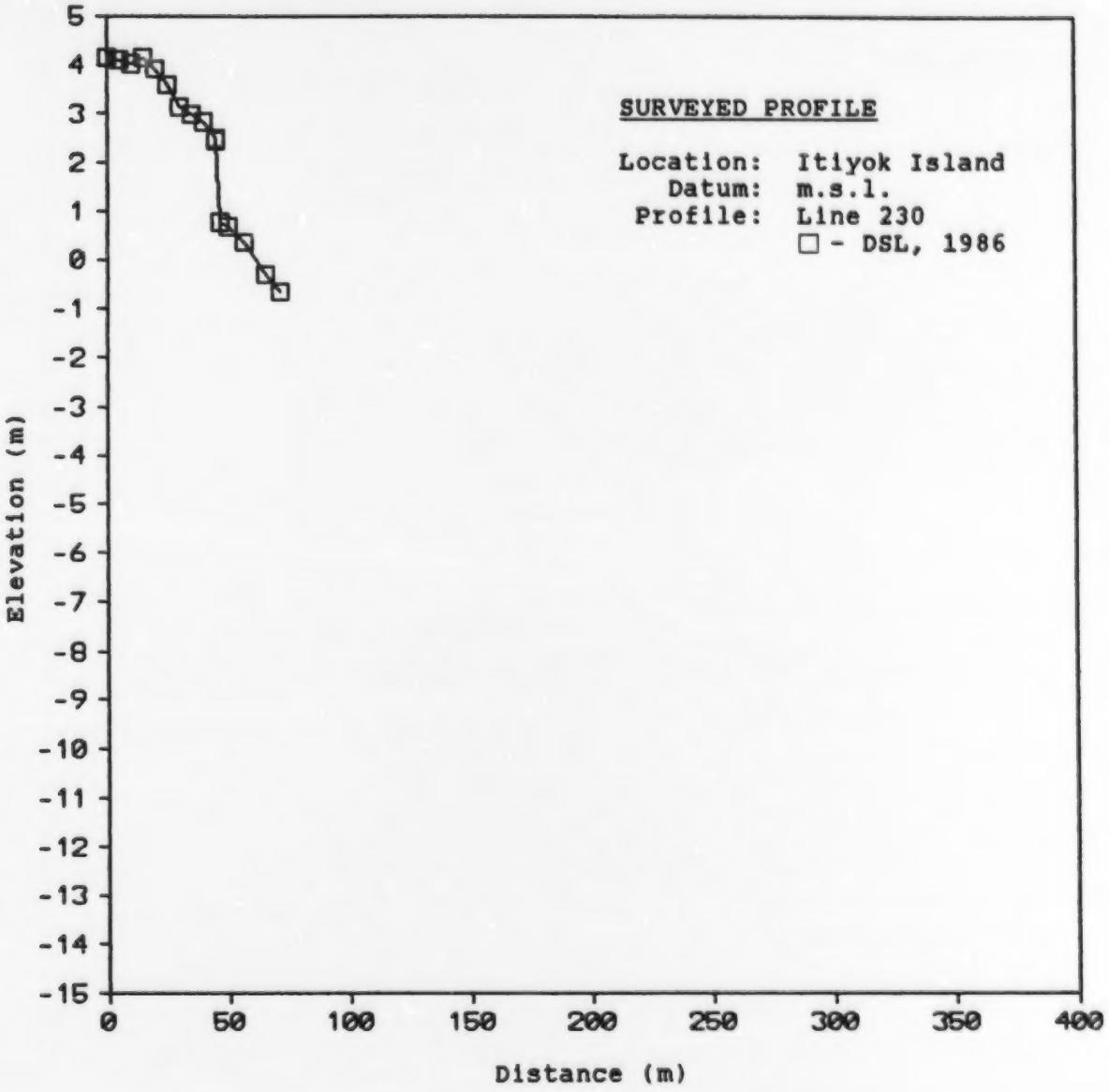

SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 180
□ - DSL, 1986
Δ - CES, 1984
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)

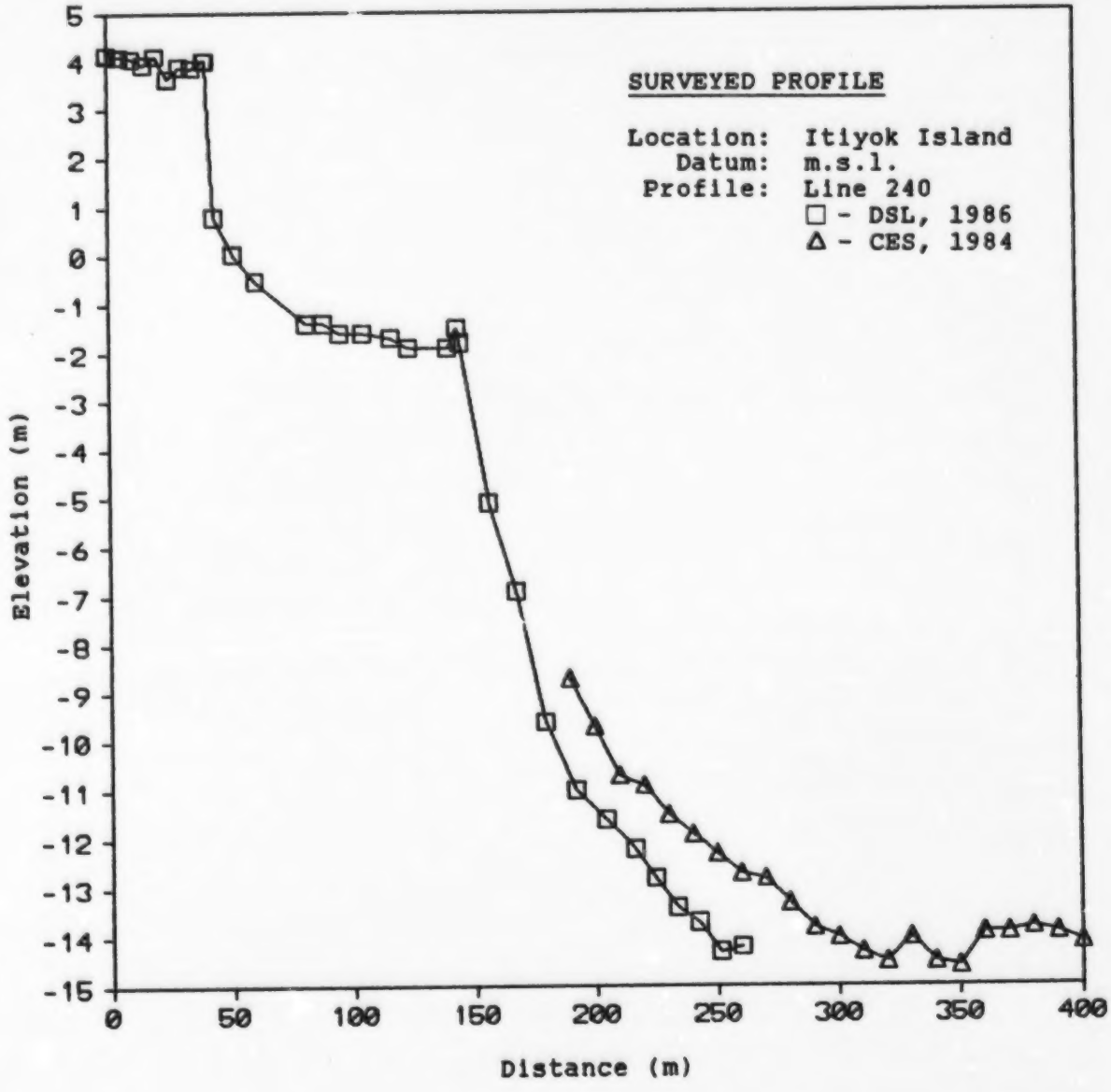

SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 190
□ - DSL, 1986
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)

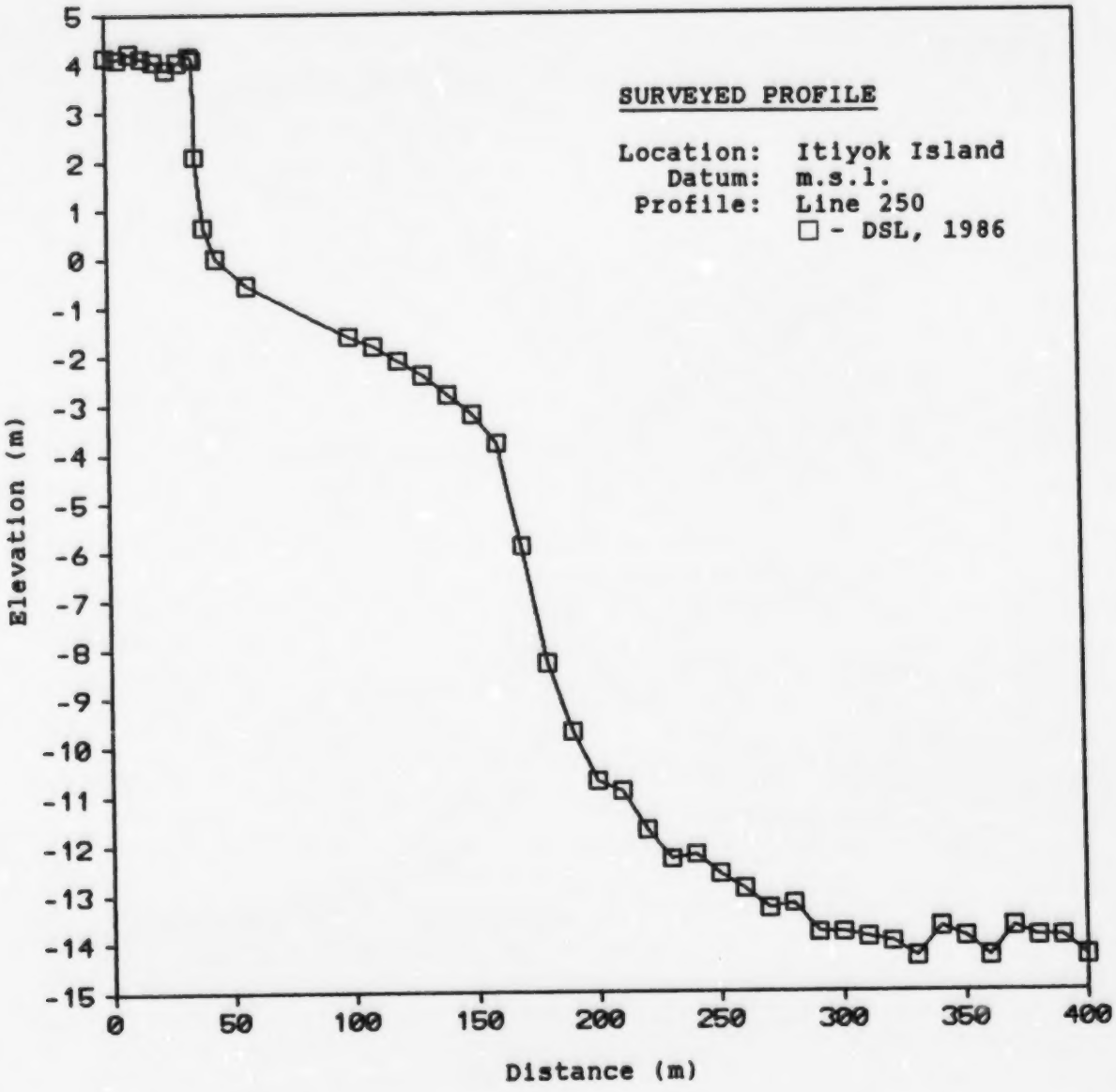

SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 200
□ - DSL, 1986
Δ - CES, 1984
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)

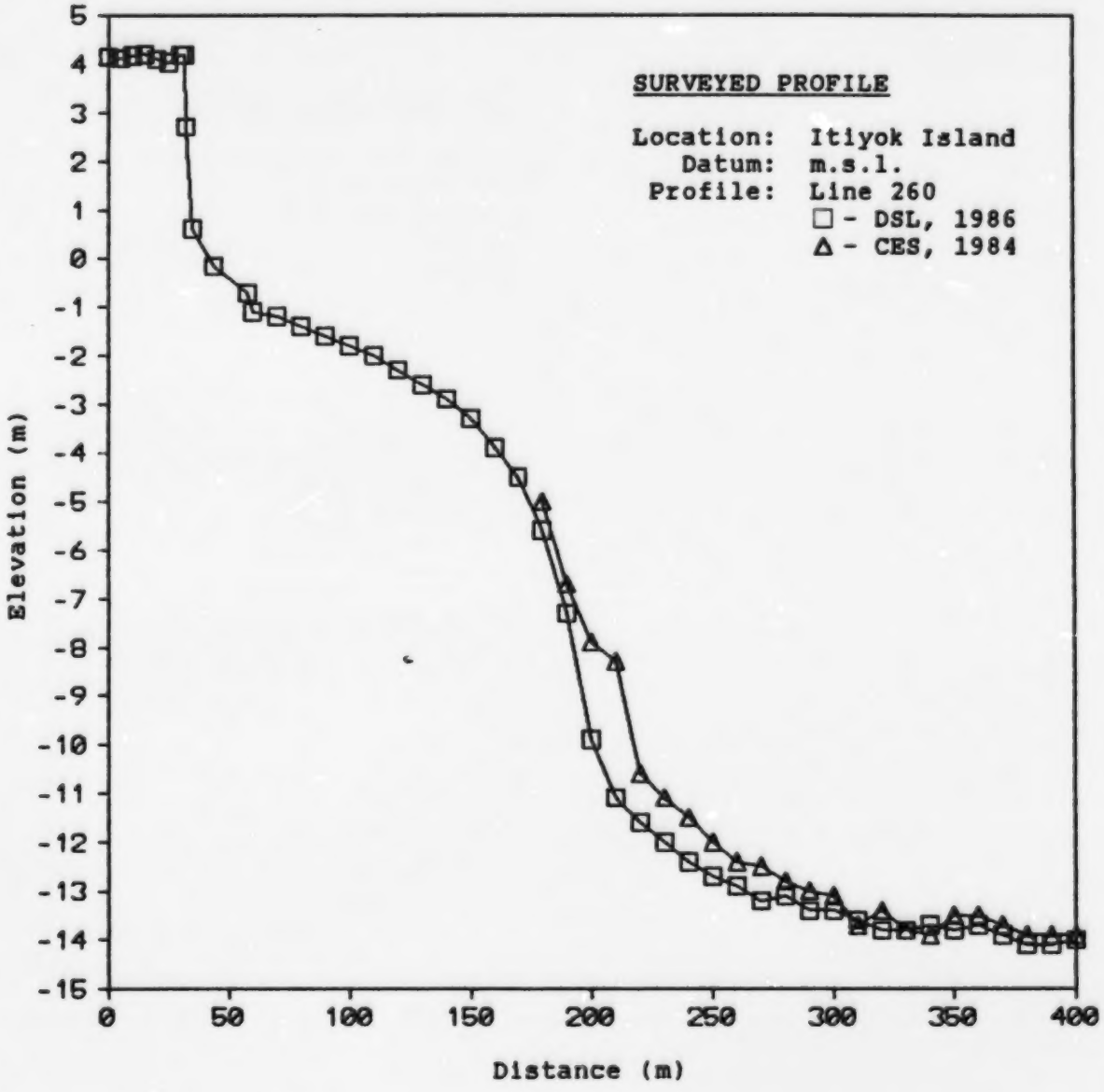

SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 210
□ - DSL, 1986
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)

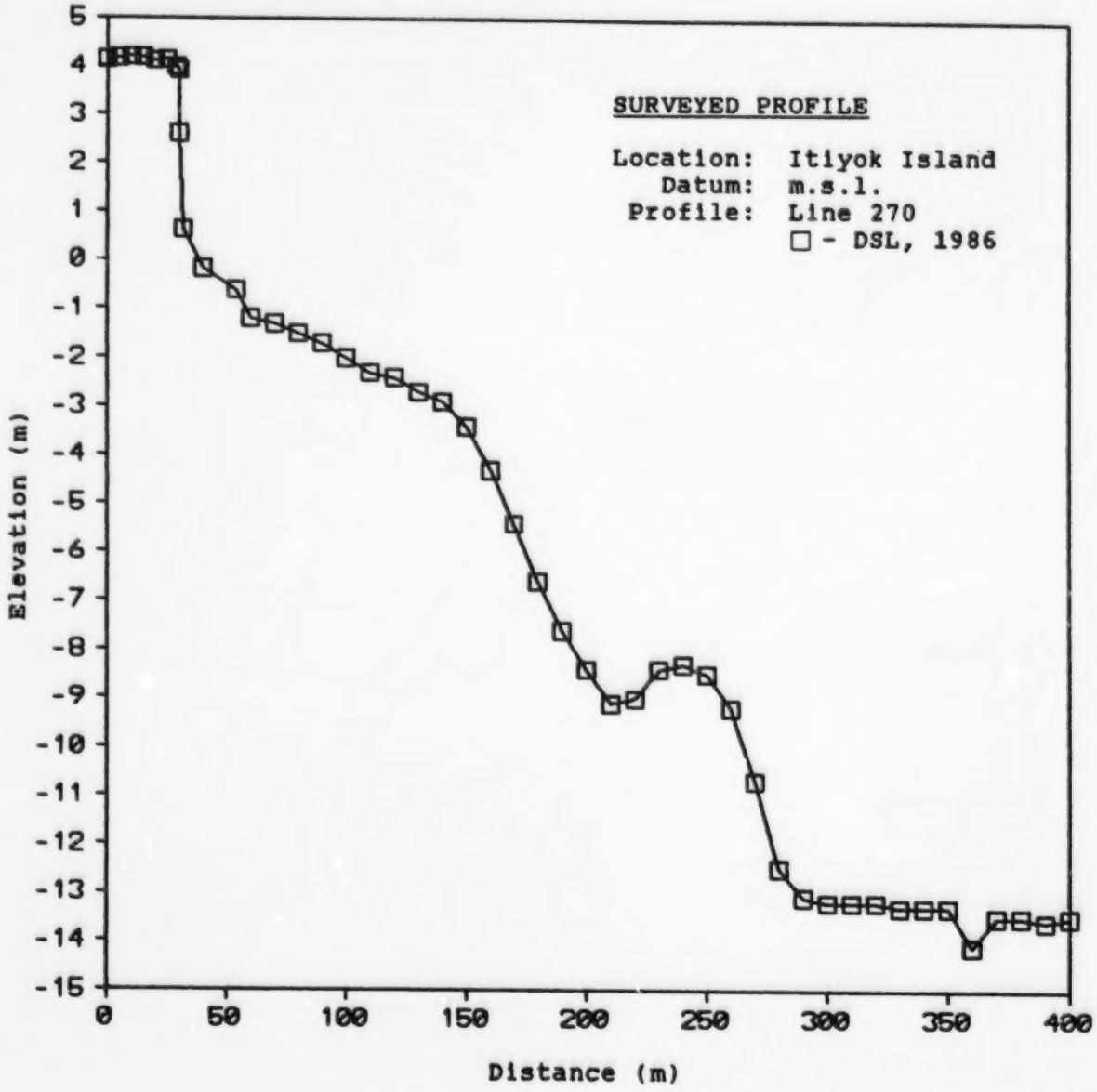

SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 220
□ - DSL, 1986
Δ - CES, 1984
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)

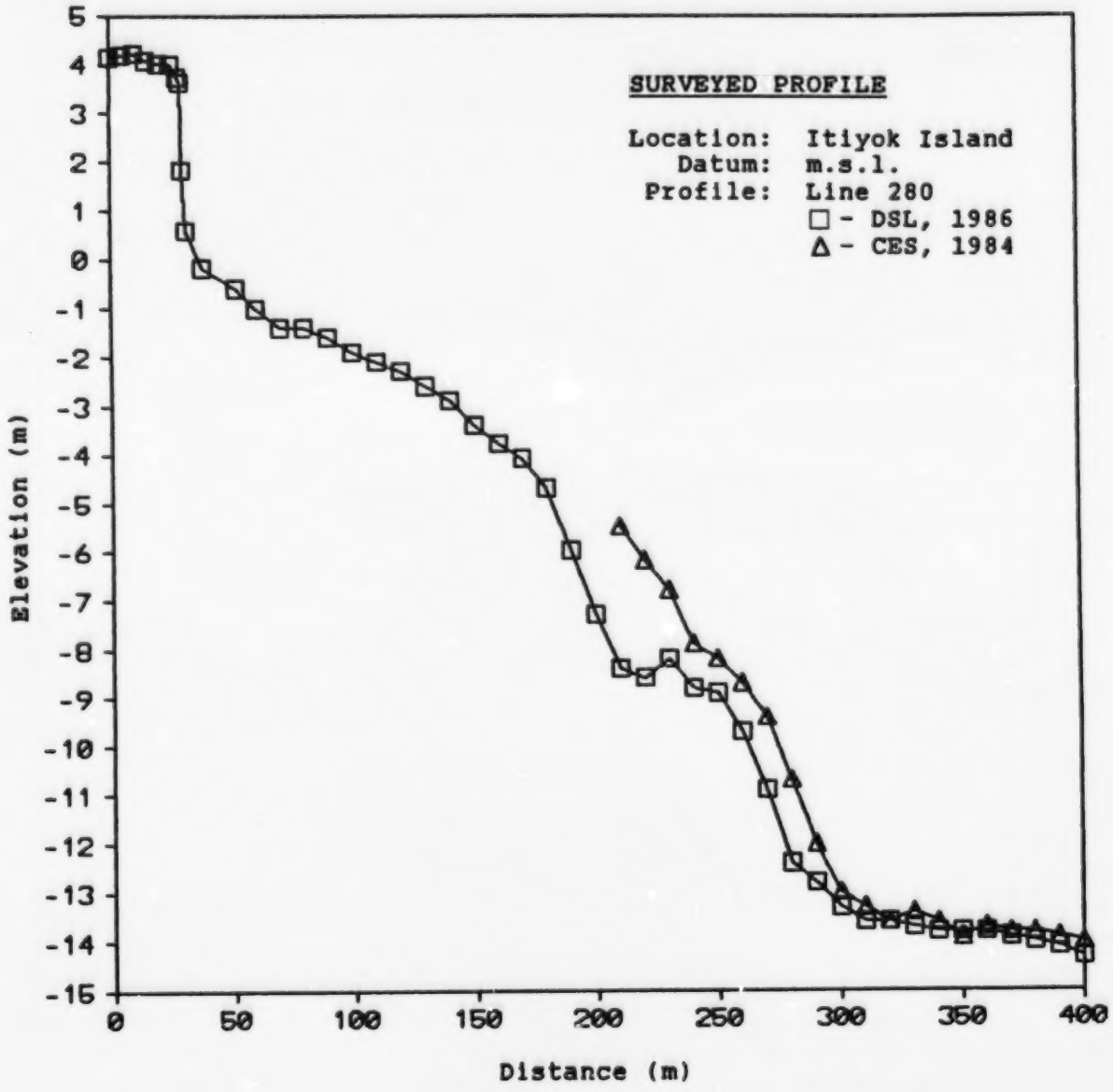

SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 230
□ - DSL, 1986
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)

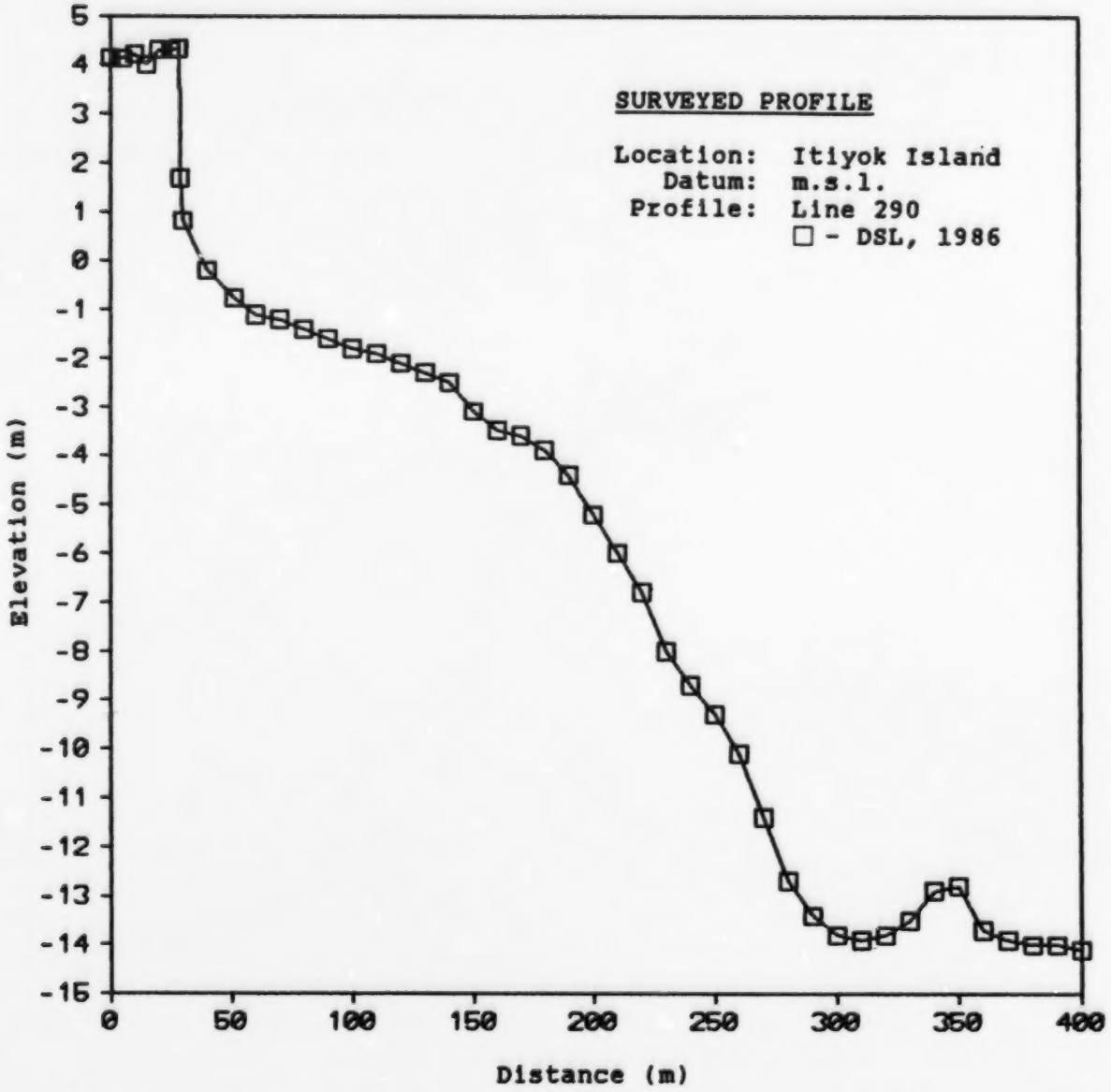

SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 240
□ - DSL, 1986
Δ - CES, 1984
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)

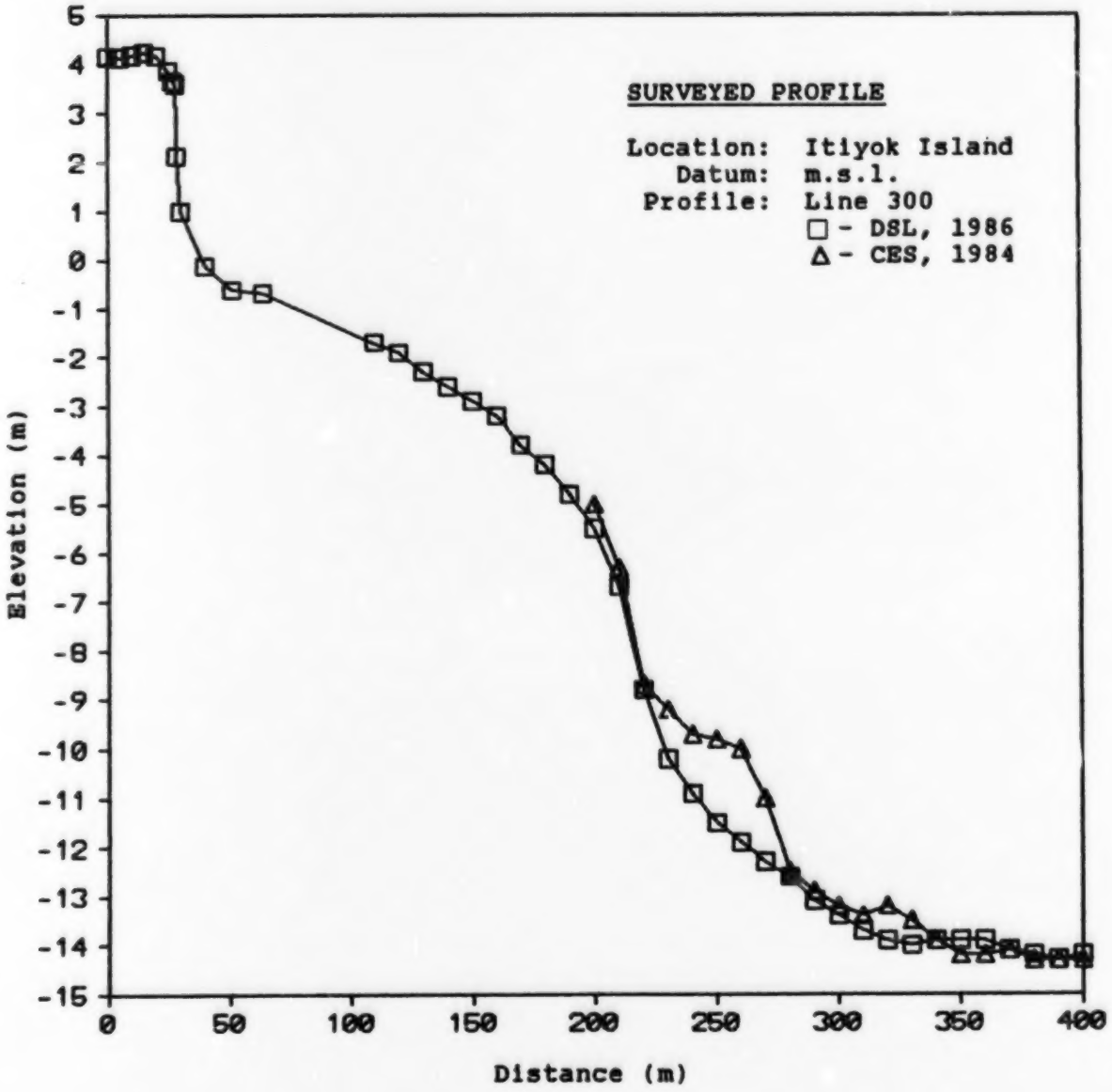

SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 250
□ - DSL, 1986
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)

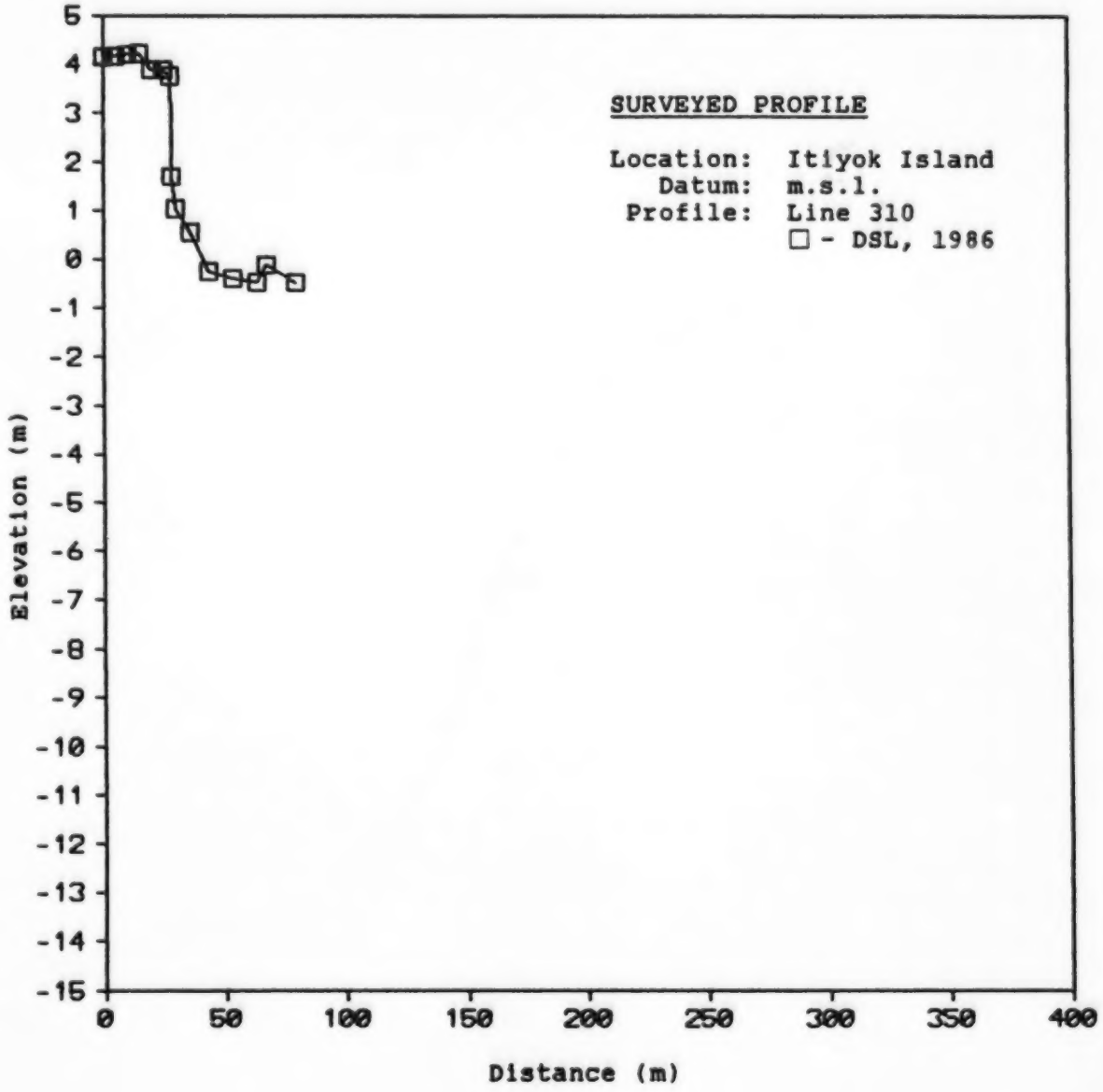

SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 260
□ - DSL, 1986
Δ - CES, 1984
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)

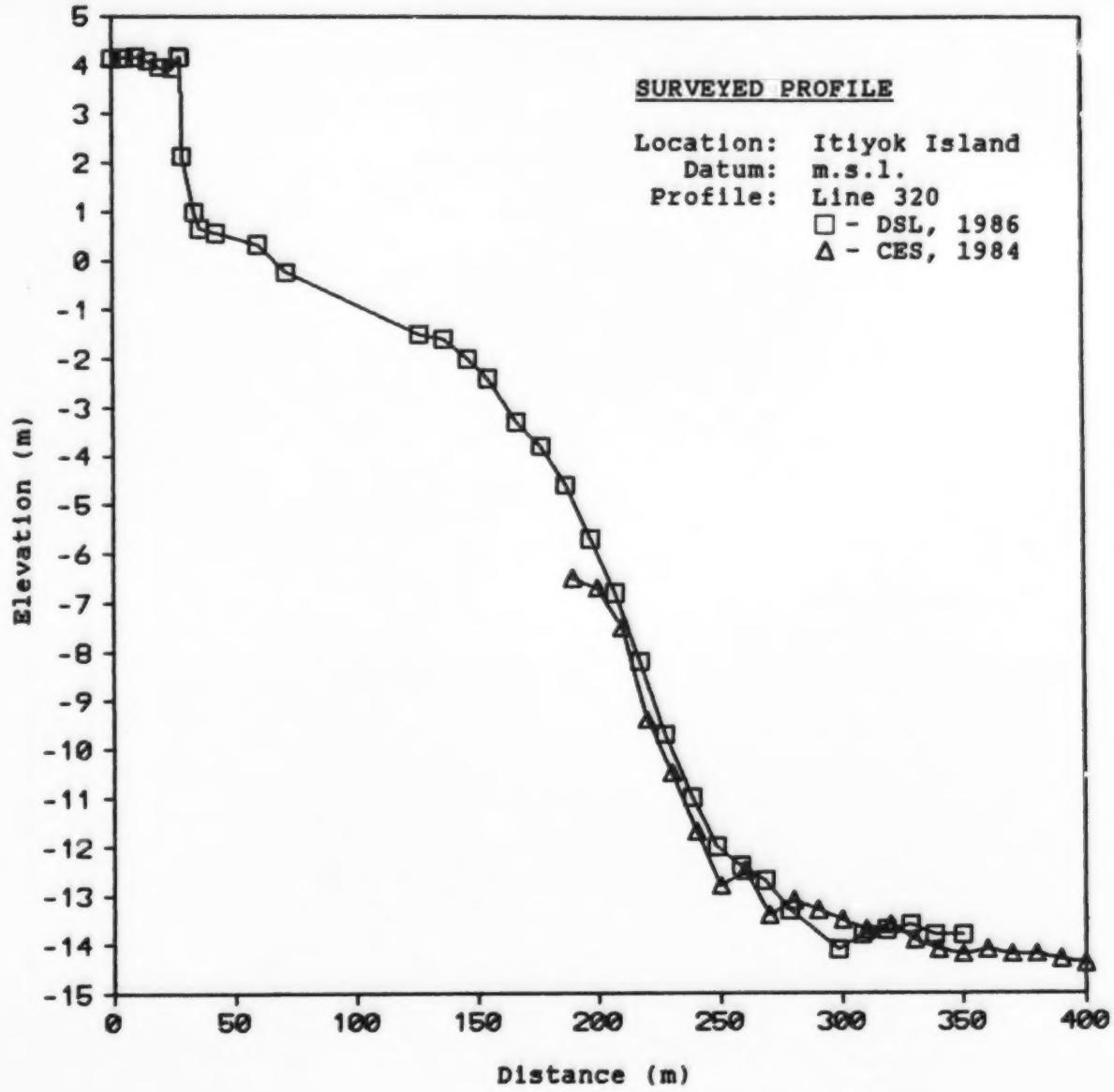

SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 270
□ - DSL, 1986
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)

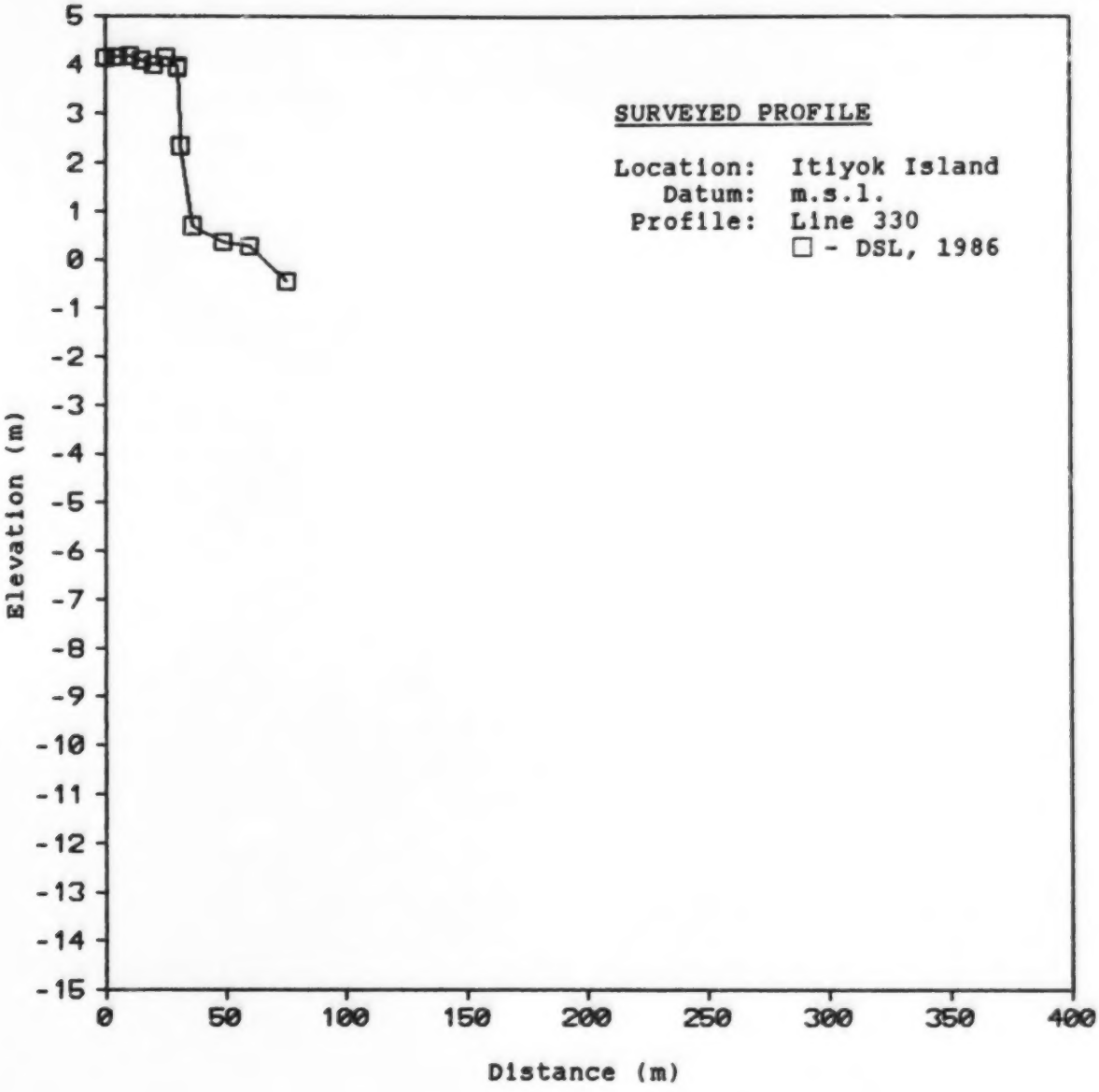

SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 280
□ - DSL, 1986
Δ - CES, 1984
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)

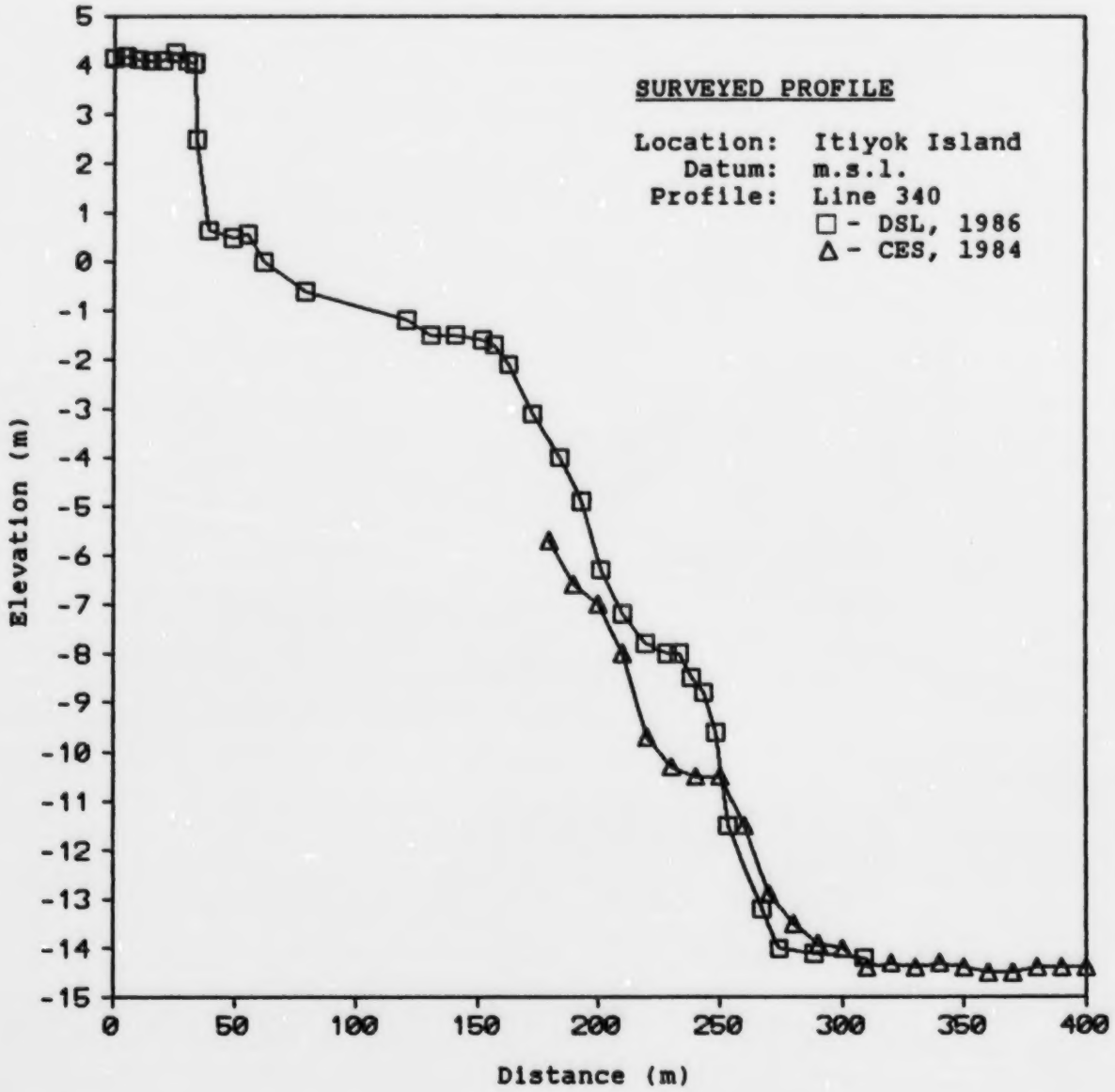

SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 290
□ - DSL, 1986
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)

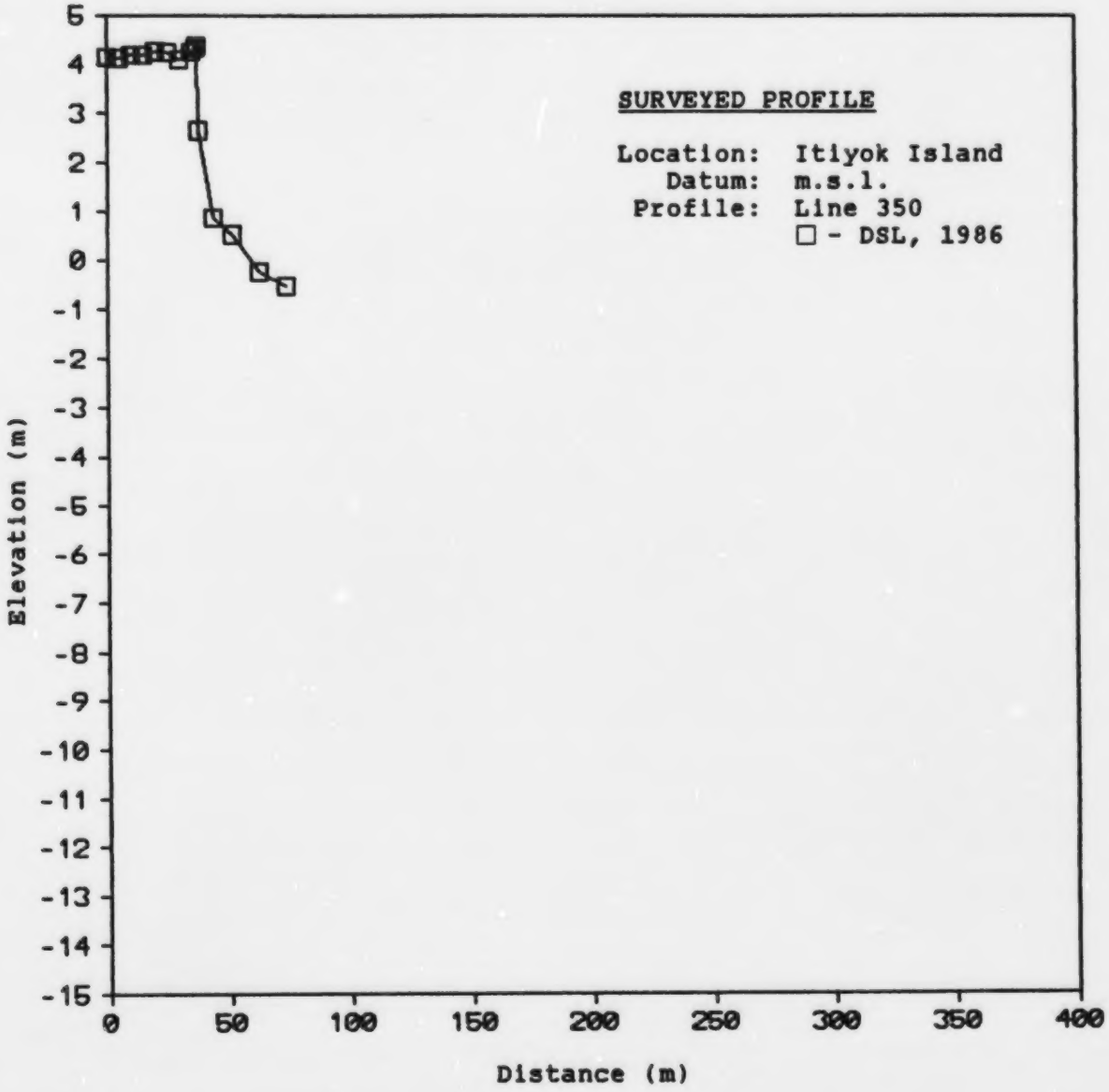

SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 300
□ - DSL, 1986
Δ - CES, 1984
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)


SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 310
□ - DSL, 1986
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)


SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 320
□ - DSL, 1986
Δ - CES, 1984
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)


SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 330
□ - DSL, 1986
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)


SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 340
□ - DSL, 1986
Δ - CES, 1984
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)


SURVEYED PROFILE
Location: Itiyok Island
Datum: m.s.l.
Profile: Line 350
□ - DSL, 1986
Elevation (m)
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
0
50
100
150
200
250
300
350
400
Distance (m)

# TABULATION OF
# DOBROCKY SEATECH LIMITED
# 1986 PROFILE DATA

DOBROCKY SEATECH LIMITED 1986 PROFILE DATA

Notes:

(1) Distances along each profile line are from the arbitrary benchmark established near the island centre during this survey.
(2) Elevation is relative to mean sea level.

| Profile Line 000 | | 010 | | 020 | | 030 | |
|---|---|---|---|---|---|---|---|
| Dist. (m) | Ele. (m) | Dist. (m) | Ele. (m) | Dist. (m) | Ele. (m) | Dist. (m) | Ele. (m) |
| 0.0 | 4.15 | 0.0 | 4.15 | 0.0 | 4.15 | 0.0 | 4.15 |
| 5.0 | 4.15 | 5.0 | 4.18 | 5.0 | 4.25 | 5.0 | 4.24 |
| 10.0 | 4.21 | 10.0 | 4.21 | 10.0 | 4.27 | 10.0 | 4.33 |
| 15.0 | 4.06 | 15.0 | 4.28 | 15.0 | 4.24 | 15.0 | 4.22 |
| 20.0 | 4.27 | 20.0 | 4.30 | 20.0 | 4.24 | 20.0 | 4.18 |
| 25.0 | 4.31 | 25.0 | 4.30 | 25.0 | 4.29 | 25.0 | 4.12 |
| 30.0 | 4.31 | 30.0 | 4.35 | 30.0 | 4.22 | 30.0 | 4.14 |
| 35.0 | 4.39 | 35.0 | 4.43 | 35.0 | 4.17 | 34.5 | 4.20 |
| 40.0 | 4.45 | 40.0 | 4.58 | 38.9 | 4.44 | 38.0 | 0.15 |
| 43.5 | 4.29 | 45.0 | 4.45 | 44.0 | 0.15 | 46.0 | -0.38 |
| 50.0 | 0.57 | 46.0 | 0.45 | 50.0 | -0.27 | 51.0 | -0.55 |
| 58.0 | -0.30 | 51.0 | -0.16 | 58.0 | -0.52 | | |
| 69.0 | -0.52 | 60.0 | -0.41 | 140.0 | -1.80 | | |
| 113.0 | -1.40 | | | 150.0 | -1.90 | | |
| 123.0 | -1.40 | | | 160.0 | -2.10 | | |
| 132.0 | -1.50 | | | 170.0 | -2.40 | | |
| 141.0 | -1.60 | | | 180.0 | -3.10 | | |
| 149.0 | -1.60 | | | 190.0 | -4.40 | | |
| 161.0 | -1.90 | | | 200.0 | -5.90 | | |
| 173.0 | -2.30 | | | 210.0 | -7.80 | | |
| 182.0 | -3.20 | | | 220.0 | -10.70 | | |
| 191.0 | -6.20 | | | 230.0 | -11.90 | | |
| 200.0 | -8.30 | | | 240.0 | -12.40 | | |
| 210.0 | -9.70 | | | 250.0 | -12.70 | | |
| 220.0 | -10.30 | | | 260.0 | -12.90 | | |
| 230.0 | -10.90 | | | 270.0 | -13.40 | | |
| 240.0 | -11.30 | | | 280.0 | -13.60 | | |
| 250.0 | -12.00 | | | 290.0 | -13.70 | | |
| 260.0 | -12.60 | | | | | | |
| 267.0 | -13.00 | | | | | | |

| Profile Line | | | | | | | |
|---|---|---|---|---|---|---|---|
| 040 | | 050 | | 060 | | 070 | |
| Dist. (m) | Ele. (m) | Dist. (m) | Ele. (m) | Dist. (m) | Ele. (m) | Dist. (m) | Ele. (m) |
| 0.0 | 4.15 | 0.0 | 4.15 | 0.0 | 4.15 | 0.0 | 4.15 |
| 5.0 | 4.26 | 5.0 | 4.27 | 5.0 | 4.20 | 5.0 | 4.18 |
| 10.0 | 4.21 | 10.0 | 4.24 | 10.0 | 4.21 | 10.0 | 4.12 |
| 15.0 | 4.14 | 15.0 | 4.10 | 15.0 | 4.09 | 15.0 | 4.11 |
| 20.0 | 4.25 | 20.0 | 4.10 | 20.0 | 4.11 | 20.0 | 4.13 |
| 25.0 | 4.15 | 25.0 | 4.08 | 25.0 | 4.13 | 23.8 | 4.16 |
| 30.0 | 4.12 | 27.4 | 4.08 | 25.4 | 4.10 | 26.0 | 0.25 |
| 32.0 | 0.41 | 30.0 | 0.22 | 27.0 | 0.37 | 33.0 | -0.28 |
| 40.0 | -0.36 | 36.0 | -0.33 | 34.0 | -0.31 | 37.0 | -0.50 |
| 50.0 | -0.63 | 43.0 | -0.58 | 39.0 | -0.50 | | |
| 160.0 | -2.40 | | | 160.0 | -2.90 | | |
| 170.0 | -2.70 | | | 170.0 | -3.20 | | |
| 180.0 | -3.10 | | | 180.0 | -3.50 | | |
| 190.0 | -3.70 | | | 190.0 | -3.80 | | |
| 200.0 | -4.80 | | | 200.0 | -4.60 | | |
| 210.0 | -7.80 | | | 210.0 | -5.40 | | |
| 220.0 | -10.00 | | | 220.0 | -6.50 | | |
| 230.0 | -11.00 | | | 230.0 | -7.90 | | |
| 240.0 | -11.70 | | | 240.0 | -9.20 | | |
| 250.0 | -12.20 | | | 250.0 | -10.60 | | |
| 260.0 | -12.70 | | | 260.0 | -11.70 | | |
| 270.0 | -13.10 | | | 270.0 | -12.40 | | |
| 280.0 | -13.40 | | | 280.0 | -12.80 | | |
| 290.0 | -13.70 | | | 290.0 | -13.10 | | |
| 300.0 | -13.80 | | | 300.0 | -13.30 | | |

| Profile Line | | | | | | | |
|---|---|---|---|---|---|---|---|
| 080 | | 090 | | 100 | | 110 | |
| Dist. (m) | Ele. (m) | Dist. (m) | Ele. (m) | Dist. (m) | Ele. (m) | Dist. (m) | Ele. (m) |
| 0.0 | 4.15 | 0.0 | 4.15 | 0.0 | 4.15 | 0.0 | 4.15 |
| 5.0 | 4.09 | 5.0 | 4.07 | 5.0 | 4.06 | 5.0 | 4.15 |
| 10.0 | 4.06 | 10.0 | 3.99 | 10.0 | 3.90 | 10.0 | 3.79 |
| 15.0 | 4.18 | 15.0 | 4.34 | 15.0 | 3.87 | 15.0 | 3.64 |
| 20.0 | 4.13 | 20.0 | 4.12 | 20.0 | 3.98 | 20.0 | 3.91 |
| 22.8 | 4.11 | 22.2 | 4.07 | 22.1 | 4.09 | 21.6 | 3.99 |
| 24.0 | 0.26 | 24.0 | 0.26 | 26.0 | 0.24 | 23.0 | 0.20 |
| 31.0 | -0.28 | 30.0 | -0.33 | 30.0 | -0.33 | 31.0 | -0.41 |
| 100.0 | -2.00 | | | 110.0 | -2.30 | | |
| 110.0 | -2.40 | | | 120.0 | -2.60 | | |
| 120.0 | -2.60 | | | 130.0 | -3.00 | | |
| 130.0 | -2.70 | | | 140.0 | -3.20 | | |
| 140.0 | -2.90 | | | 150.0 | -3.60 | | |
| 150.0 | -3.10 | | | 160.0 | -4.40 | | |
| 160.0 | -3.40 | | | 170.0 | -6.40 | | |
| 170.0 | -3.80 | | | 180.0 | -7.70 | | |
| 180.0 | -4.30 | | | 190.0 | -8.70 | | |
| 190.0 | -5.10 | | | 200.0 | -9.50 | | |
| 200.0 | -6.30 | | | 210.0 | -10.30 | | |
| 210.0 | -7.50 | | | 220.0 | -11.00 | | |
| 220.0 | -8.20 | | | 230.0 | -11.70 | | |
| 230.0 | -8.60 | | | 240.0 | -12.30 | | |
| 240.0 | -9.50 | | | 250.0 | -12.30 | | |
| 250.0 | -10.70 | | | 260.0 | -12.70 | | |
| 260.0 | -11.70 | | | 270.0 | -12.90 | | |
| 270.0 | -12.30 | | | 280.0 | -13.10 | | |
| 280.0 | -12.70 | | | 290.0 | -13.20 | | |
| 290.0 | -13.00 | | | 300.0 | -13.40 | | |
| 300.0 | -13.30 | | | 310.0 | -13.40 | | |
| 310.0 | -13.40 | | | 320.0 | -13.40 | | |
| 320.0 | -13.50 | | | 330.0 | -13.40 | | |

Profile Line

| 120 | | 130 | | 140 | | 150 | |
|---|---|---|---|---|---|---|---|
| Dist. (m) | Ele. (m) | Dist. (m) | Ele. (m) | Dist. (m) | Ele. (m) | Dist. (m) | Ele. (m) |
| 0.0 | 4.15 | 0.0 | 4.15 | 0.0 | 4.15 | 0.0 | 4.15 |
| 5.0 | 4.09 | 5.0 | 4.32 | 5.0 | 4.18 | 5.0 | 4.14 |
| 10.0 | 4.17 | 10.0 | 4.10 | 10.0 | 4.10 | 10.0 | 4.07 |
| 15.0 | 3.75 | 15.0 | 4.11 | 15.0 | 4.06 | 15.0 | 3.95 |
| 20.0 | 3.39 | 20.0 | 4.14 | 20.0 | 3.87 | 20.0 | 3.79 |
| 23.5 | 3.14 | 24.1 | 3.76 | 24.9 | 3.91 | 25.0 | 3.59 |
| 26.0 | 0.17 | 27.0 | 0.12 | 26.0 | 0.22 | 25.7 | 3.56 |
| 32.0 | -0.37 | 32.0 | -0.38 | 36.0 | -0.41 | 29.0 | 0.21 |
| 110.0 | -2.10 | | | 110.0 | -2.20 | 35.0 | -0.22 |
| 120.0 | -2.40 | | | 120.0 | -2.30 | 40.0 | -0.45 |
| 130.0 | -2.70 | | | 130.0 | -2.60 | | |
| 140.0 | -3.10 | | | 140.0 | -3.10 | | |
| 150.0 | -4.00 | | | 150.0 | -3.90 | | |
| 160.0 | -5.60 | | | 160.0 | -5.20 | | |
| 170.0 | -7.70 | | | 170.0 | -6.30 | | |
| 180.0 | -8.90 | | | 180.0 | -8.70 | | |
| 190.0 | -9.80 | | | 190.0 | -10.30 | | |
| 200.0 | -10.70 | | | 200.0 | -11.40 | | |
| 210.0 | -11.30 | | | 210.0 | -12.00 | | |
| 220.0 | -11.80 | | | 220.0 | -12.20 | | |
| 230.0 | -12.20 | | | 230.0 | -12.30 | | |
| 240.0 | -12.30 | | | 240.0 | -12.90 | | |
| 250.0 | -12.40 | | | 250.0 | -13.30 | | |
| 260.0 | -12.80 | | | 260.0 | -13.40 | | |
| 270.0 | -13.10 | | | 270.0 | -13.60 | | |
| 280.0 | -13.20 | | | 280.0 | -13.60 | | |
| 290.0 | -13.00 | | | 290.0 | -13.70 | | |
| 300.0 | -13.30 | | | | | | |
| 310.0 | -13.60 | | | | | | |
| 320.0 | -13.50 | | | | | | |
| 330.0 | -13.70 | | | | | | |
| 340.0 | -13.80 | | | | | | |
| 350.0 | -13.80 | | | | | | |

| Profile Line | | | | | | | |
|---|---|---|---|---|---|---|---|
| 160 | | 170 | | 180 | | 190 | |
| Dist. (m) | Ele. (m) | Dist. (m) | Ele. (m) | Dist. (m) | Ele. (m) | Dist. (m) | Ele. (m) |
| 0.0 | 4.15 | 0.0 | 4.15 | 0.0 | 4.15 | 0.0 | 4.15 |
| 5.0 | 4.14 | 5.0 | 4.06 | 5.0 | 4.05 | 5.0 | 4.05 |
| 10.0 | 4.10 | 10.0 | 4.07 | 10.0 | 3.95 | 10.0 | 3.95 |
| 15.0 | 3.84 | 15.0 | 3.75 | 15.0 | 3.63 | 15.0 | 3.62 |
| 20.0 | 3.38 | 20.0 | 3.29 | 20.0 | 3.14 | 20.0 | 3.23 |
| 25.0 | 3.17 | 25.0 | 2.76 | 25.0 | 2.80 | 25.0 | 3.08 |
| 28.1 | 2.99 | 30.0 | 2.32 | 30.0 | 2.11 | 30.0 | 2.42 |
| 30.0 | 0.31 | 30.3 | 2.30 | 32.0 | 1.85 | 33.0 | 2.03 |
| 35.0 | -0.18 | 34.0 | 0.35 | 32.6 | 1.78 | 35.5 | 1.71 |
| 45.0 | -0.50 | 40.0 | 0.01 | 34.0 | 0.57 | 37.0 | 0.66 |
| 110.0 | -1.60 | 48.0 | -0.44 | 40.0 | 0.17 | 45.0 | 0.22 |
| 120.0 | -1.80 | | | 50.0 | -0.17 | 59.0 | -0.28 |
| 130.0 | -2.10 | | | 130.0 | -1.60 | | |
| 140.0 | -2.70 | | | 140.0 | -2.20 | | |
| 150.0 | -3.60 | | | 150.0 | -2.30 | | |
| 160.0 | -5.70 | | | 160.0 | -3.70 | | |
| 170.0 | -9.90 | | | 170.0 | -8.00 | | |
| 180.0 | -11.40 | | | 180.0 | -11.60 | | |
| 190.0 | -12.40 | | | 190.0 | -13.00 | | |
| 200.0 | -13.20 | | | 200.0 | -13.60 | | |
| 210.0 | -13.60 | | | 210.0 | -13.90 | | |
| 220.0 | -13.50 | | | 220.0 | -14.10 | | |
| 230.0 | -13.60 | | | 230.0 | -14.20 | | |
| 240.0 | -13.80 | | | | | | |
| 250.0 | -13.80 | | | | | | |

| Profile Line | | | | | | | |
|---|---|---|---|---|---|---|---|
| 200 | | 210 | | 220 | | 230 | |
| Dist. (m) | Ele. (m) | Dist. (m) | Ele. (m) | Dist. (m) | Ele. (m) | Dist. (m) | Ele. (m) |
| 0.0 | 4.15 | 0.0 | 4.15 | 0.0 | 4.15 | 0.0 | 4.15 |
| 5.0 | 4.09 | 5.0 | 4.08 | 5.0 | 4.06 | 5.0 | 4.10 |
| 10.0 | 3.92 | 10.0 | 3.90 | 10.0 | 4.02 | 10.0 | 4.02 |
| 15.0 | 3.60 | 15.0 | 3.67 | 15.0 | 3.90 | 15.0 | 4.15 |
| 20.0 | 3.66 | 20.0 | 3.82 | 20.0 | 4.02 | 20.0 | 3.92 |
| 25.0 | 3.46 | 25.0 | 3.72 | 25.0 | 3.49 | 25.0 | 3.60 |
| 30.0 | 3.45 | 30.0 | 3.19 | 30.0 | 3.30 | 30.0 | 3.14 |
| 35.0 | 2.54 | 35.0 | 2.83 | 35.0 | 2.63 | 35.0 | 2.99 |
| 39.0 | 2.20 | 40.0 | 2.82 | 40.0 | 2.19 | 40.0 | 2.83 |
| 39.1 | 2.22 | 45.0 | 2.32 | 45.0 | 2.15 | 45.0 | 2.49 |
| 43.0 | 0.61 | 45.2 | 2.33 | 46.4 | 2.11 | 45.3 | 2.45 |
| 52.0 | 0.25 | 46.0 | 0.85 | 48.0 | 0.92 | 47.0 | 0.78 |
| 60.0 | 0.07 | 49.0 | 0.58 | 60.0 | 0.57 | 50.0 | 0.69 |
| 72.0 | -0.31 | 56.0 | 0.53 | 62.0 | 0.32 | 57.0 | 0.37 |
| 103.0 | -1.80 | 66.0 | 0.03 | 74.0 | 0.22 | 66.0 | -0.29 |
| 113.0 | -1.90 | 80.0 | -0.28 | 85.0 | -0.08 | 72.0 | -0.65 |
| 120.0 | -1.90 | | | 105.0 | -0.40 | | |
| 126.0 | -1.80 | | | 133.0 | -1.50 | | |
| 135.0 | -1.70 | | | 146.0 | -1.60 | | |
| 145.0 | -1.70 | | | 159.0 | -1.90 | | |
| 159.0 | -2.30 | | | 162.0 | -2.60 | | |
| 175.0 | -3.70 | | | 171.0 | -6.90 | | |
| 185.0 | -7.50 | | | 182.0 | -9.50 | | |
| 195.0 | -12.20 | | | 194.0 | -11.50 | | |
| 205.0 | -13.70 | | | 202.0 | -12.70 | | |
| 215.0 | -13.70 | | | 211.0 | -13.40 | | |
| 226.0 | -13.90 | | | 219.0 | -13.70 | | |
| 237.0 | -14.00 | | | 227.0 | -13.90 | | |
| 247.0 | -14.20 | | | 238.0 | -14.30 | | |
| 257.0 | -14.30 | | | 249.0 | -13.80 | | |
| 268.0 | -14.40 | | | 261.0 | -15.10 | | |
| 278.0 | -14.20 | | | 273.0 | -14.50 | | |
| 288.0 | -14.30 | | | 284.0 | -14.10 | | |
| 298.0 | -14.20 | | | 296.0 | -14.40 | | |
| 310.0 | -14.30 | | | | | | |
| 320.0 | -14.70 | | | | | | |
| 330.0 | -14.70 | | | | | | |
| 340.0 | -14.80 | | | | | | |
| 350.0 | -14.70 | | | | | | |
| 360.0 | -14.70 | | | | | | |

Profile Line

| 240 | | 250 | | 260 | | 270 | |
|---|---|---|---|---|---|---|---|
| Dist. (m) | Ele. (m) | Dist. (m) | Ele. (m) | Dist. (m) | Ele. (m) | Dist. (m) | Ele. (m) |
| 0.0 | 4.15 | 0.0 | 4.15 | 0.0 | 4.15 | 0.0 | 4.15 |
| 5.0 | 4.11 | 5.0 | 4.11 | 5.0 | 4.12 | 5.0 | 4.18 |
| 10.0 | 4.07 | 10.0 | 4.22 | 10.0 | 4.18 | 10.0 | 4.20 |
| 15.0 | 3.93 | 15.0 | 4.12 | 15.0 | 4.21 | 15.0 | 4.19 |
| 20.0 | 4.12 | 20.0 | 4.05 | 20.0 | 4.11 | 20.0 | 4.12 |
| 25.0 | 3.63 | 25.0 | 3.88 | 25.0 | 4.04 | 25.0 | 4.14 |
| 30.0 | 3.88 | 30.0 | 4.04 | 30.0 | 4.19 | 29.0 | 4.00 |
| 35.0 | 3.86 | 35.0 | 4.17 | 31.8 | 4.19 | 29.9 | 3.92 |
| 40.0 | 4.03 | 36.4 | 4.09 | 32.3 | 2.72 | 30.2 | 2.60 |
| 40.8 | 4.02 | 36.7 | 2.10 | 35.0 | 0.61 | 32.0 | 0.62 |
| 44.0 | 0.80 | 40.0 | 0.65 | 44.0 | -0.16 | 40.0 | -0.18 |
| 52.0 | 0.03 | 45.0 | 0.01 | 58.0 | -0.72 | 54.0 | -0.62 |
| 61.0 | -0.52 | 58.0 | -0.55 | 60.0 | -1.10 | 60.0 | -1.20 |
| 82.0 | -1.40 | 100.0 | -1.60 | 70.0 | -1.20 | 70.0 | -1.30 |
| 89.0 | -1.40 | 110.0 | -1.80 | 80.0 | -1.40 | 80.0 | -1.50 |
| 96.0 | -1.60 | 120.0 | -2.10 | 90.0 | -1.60 | 90.0 | -1.70 |
| 105.0 | -1.60 | 130.0 | -2.40 | 100.0 | -1.80 | 100.0 | -2.00 |
| 117.0 | -1.70 | 140.0 | -2.80 | 110.0 | -2.00 | 110.0 | -2.30 |
| 124.0 | -1.90 | 150.0 | -3.20 | 120.0 | -2.30 | 120.0 | -2.40 |
| 140.0 | -1.90 | 160.0 | -3.80 | 130.0 | -2.60 | 130.0 | -2.70 |
| 144.0 | -1.50 | 170.0 | -5.90 | 140.0 | -2.90 | 140.0 | -2.90 |
| 145.0 | -1.80 | 180.0 | -8.30 | 150.0 | -3.30 | 150.0 | -3.40 |
| 157.0 | -5.10 | 190.0 | -9.70 | 160.0 | -3.90 | 160.0 | -4.30 |
| 168.0 | -6.90 | 200.0 | -10.70 | 170.0 | -4.50 | 170.0 | -5.40 |
| 180.0 | -9.60 | 210.0 | -10.90 | 180.0 | -5.60 | 180.0 | -6.60 |
| 192.0 | -11.00 | 220.0 | -11.70 | 190.0 | -7.30 | 190.0 | -7.60 |
| 204.0 | -11.60 | 230.0 | -12.30 | 200.0 | -9.90 | 200.0 | -8.40 |
| 216.0 | -12.20 | 240.0 | -12.20 | 210.0 | -11.10 | 210.0 | -9.10 |
| 224.0 | -12.80 | 250.0 | -12.60 | 220.0 | -11.60 | 220.0 | -9.00 |
| 233.0 | -13.40 | 260.0 | -12.90 | 230.0 | -12.00 | 230.0 | -8.40 |
| 242.0 | -13.70 | 270.0 | -13.30 | 240.0 | -12.40 | 240.0 | -8.30 |
| 251.0 | -14.30 | 280.0 | -13.20 | 250.0 | -12.70 | 250.0 | -8.50 |
| 260.0 | -14.20 | 290.0 | -13.80 | 260.0 | -12.90 | 260.0 | -9.20 |
| | | 300.0 | -13.80 | 270.0 | -13.20 | 270.0 | -10.70 |
| | | 310.0 | -13.90 | 280.0 | -13.10 | 280.0 | -12.50 |
| | | 320.0 | -14.00 | 290.0 | -13.40 | 290.0 | -13.10 |
| | | 330.0 | -14.30 | 300.0 | -13.40 | 300.0 | -13.20 |
| | | 340.0 | -13.70 | 310.0 | -13.60 | 310.0 | -13.20 |
| | | 350.0 | -13.90 | 320.0 | -13.80 | 320.0 | -13.20 |
| | | 360.0 | -14.30 | 330.0 | -13.80 | 330.0 | -13.30 |
| | | 370.0 | -13.70 | 340.0 | -13.70 | 340.0 | -13.30 |
| | | 380.0 | -13.90 | 350.0 | -13.80 | 350.0 | -13.30 |
| | | 390.0 | -13.90 | 360.0 | -13.70 | 360.0 | -14.10 |
| | | 400.0 | -14.30 | 370.0 | -13.90 | 370.0 | -13.50 |
| | | | | 380.0 | -14.10 | 380.0 | -13.50 |
| | | | | 390.0 | -14.10 | 390.0 | -13.60 |
| | | | | 400.0 | -14.00 | 400.0 | -13.50 |

Profile Line

| 280 | | 290 | | 300 | | 310 | |
|---|---|---|---|---|---|---|---|
| Dist. (m) | Ele. (m) | Dist. (m) | Ele. (m) | Dist. (m) | Ele. (m) | Dist. (m) | Ele. (m) |
| 0.0 | 4.15 | 0.0 | 4.15 | 0.0 | 4.15 | 0.0 | 4.15 |
| 5.0 | 4.19 | 5.0 | 4.13 | 5.0 | 4.13 | 5.0 | 4.16 |
| 10.0 | 4.23 | 10.0 | 4.22 | 10.0 | 4.18 | 10.0 | 4.20 |
| 15.0 | 4.08 | 15.0 | 4.01 | 15.0 | 4.24 | 15.0 | 4.22 |
| 20.0 | 4.02 | 20.0 | 4.32 | 20.0 | 4.17 | 20.0 | 3.89 |
| 25.0 | 4.01 | 25.0 | 4.31 | 25.0 | 3.86 | 25.0 | 3.89 |
| 28.0 | 3.74 | 28.0 | 4.35 | 27.0 | 3.66 | 28.0 | 3.76 |
| 28.9 | 3.64 | 28.2 | 4.35 | 27.7 | 3.59 | 28.7 | 1.70 |
| 29.6 | 1.82 | 29.0 | 1.69 | 28.5 | 2.13 | 30.0 | 1.03 |
| 31.0 | 0.59 | 30.0 | 0.82 | 30.0 | 1.00 | 36.0 | 0.55 |
| 38.0 | -0.18 | 40.0 | -0.20 | 40.0 | -0.12 | 44.0 | -0.25 |
| 52.0 | -0.59 | 51.0 | -0.77 | 51.0 | -0.60 | 54.0 | -0.40 |
| 60.0 | -1.01 | 60.0 | -1.10 | 64.0 | -0.67 | 64.0 | -0.47 |
| 70.0 | -1.40 | 70.0 | -1.20 | 110.0 | -1.70 | 68.0 | -0.12 |
| 80.0 | -1.40 | 80.0 | -1.40 | 120.0 | -1.90 | 80.0 | -0.48 |
| 90.0 | -1.60 | 90.0 | -1.60 | 130.0 | -2.30 | | |
| 100.0 | -1.90 | 100.0 | -1.80 | 140.0 | -2.60 | | |
| 110.0 | -2.10 | 110.0 | -1.90 | 150.0 | -2.90 | | |
| 120.0 | -2.30 | 120.0 | -2.10 | 160.0 | -3.20 | | |
| 130.0 | -2.60 | 130.0 | -2.30 | 170.0 | -3.80 | | |
| 140.0 | -2.90 | 140.0 | -2.50 | 180.0 | -4.20 | | |
| 150.0 | -3.40 | 150.0 | -3.10 | 190.0 | -4.80 | | |
| 160.0 | -3.80 | 160.0 | -3.50 | 200.0 | -5.50 | | |
| 170.0 | -4.10 | 170.0 | -3.60 | 210.0 | -6.70 | | |
| 180.0 | -4.70 | 180.0 | -3.90 | 220.0 | -8.80 | | |
| 190.0 | -6.00 | 190.0 | -4.40 | 230.0 | -10.20 | | |
| 200.0 | -7.30 | 200.0 | -5.20 | 240.0 | -10.90 | | |
| 210.0 | -8.40 | 210.0 | -6.00 | 250.0 | -11.50 | | |
| 220.0 | -8.60 | 220.0 | -6.80 | 260.0 | -11.90 | | |
| 230.0 | -8.20 | 230.0 | -8.00 | 270.0 | -12.30 | | |
| 240.0 | -8.80 | 240.0 | -8.70 | 280.0 | -12.60 | | |
| 250.0 | -8.90 | 250.0 | -9.30 | 290.0 | -13.10 | | |
| 260.0 | -9.70 | 260.0 | -10.10 | 300.0 | -13.40 | | |
| 270.0 | -10.90 | 270.0 | -11.40 | 310.0 | -13.70 | | |
| 280.0 | -12.40 | 280.0 | -12.70 | 320.0 | -13.90 | | |
| 290.0 | -12.80 | 290.0 | -13.40 | 330.0 | -14.00 | | |
| 300.0 | -13.30 | 300.0 | -13.80 | 340.0 | -13.90 | | |
| 310.0 | -13.60 | 310.0 | -13.90 | 350.0 | -13.90 | | |
| 320.0 | -13.60 | 320.0 | -13.80 | 360.0 | -13.90 | | |
| 330.0 | -13.70 | 330.0 | -13.50 | 370.0 | -14.10 | | |
| 340.0 | -13.80 | 340.0 | -12.90 | 380.0 | -14.20 | | |
| 350.0 | -13.80 | 350.0 | -12.80 | 390.0 | -14.30 | | |
| 360.0 | -13.80 | 360.0 | -13.70 | 400.0 | -14.20 | | |
| 370.0 | -13.90 | 370.0 | -13.90 | | | | |
| 380.0 | -14.00 | 380.0 | -14.00 | | | | |
| 390.0 | -14.10 | 390.0 | -14.00 | | | | |
| 400.0 | -14.30 | 400.0 | -14.10 | | | | |

Profile Line

| 320 | | 330 | | 340 | | 350 | |
|---|---|---|---|---|---|---|---|
| Dist. (m) | Ele. (m) | Dist. (m) | Ele. (m) | Dist. (m) | Ele. (m) | Dist. (m) | Ele. (m) |
| 0.0 | 4.15 | 0.0 | 4.15 | 0.0 | 4.15 | 0.0 | 4.15 |
| 5.0 | 4.16 | 5.0 | 4.17 | 5.0 | 4.18 | 5.0 | 4.13 |
| 10.0 | 4.18 | 10.0 | 4.19 | 10.0 | 4.12 | 10.0 | 4.20 |
| 15.0 | 4.09 | 15.0 | 4.10 | 15.0 | 4.09 | 15.0 | 4.19 |
| 20.0 | 3.95 | 20.0 | 4.00 | 20.0 | 4.10 | 20.0 | 4.27 |
| 25.0 | 3.92 | 25.0 | 4.16 | 25.0 | 4.25 | 25.0 | 4.25 |
| 28.0 | 4.18 | 30.0 | 3.98 | 30.0 | 4.09 | 30.0 | 4.10 |
| 28.2 | 4.17 | 30.4 | 3.94 | 33.0 | 4.04 | 35.0 | 4.26 |
| 29.1 | 2.13 | 31.4 | 2.34 | 33.4 | 4.05 | 37.0 | 4.34 |
| 34.0 | 0.99 | 36.0 | 0.70 | 34.2 | 2.49 | 37.3 | 4.38 |
| 36.0 | 0.66 | 49.0 | 0.37 | 39.0 | 0.62 | 38.0 | 2.65 |
| 43.0 | 0.56 | 60.0 | 0.28 | 49.0 | 0.47 | 44.0 | 0.86 |
| 60.0 | 0.33 | 76.0 | -0.46 | 55.0 | 0.55 | 52.0 | 0.52 |
| 72.0 | -0.23 | | | 62.0 | -0.01 | 63.0 | -0.24 |
| 127.0 | -1.50 | | | 79.0 | -0.61 | 74.0 | -0.53 |
| 137.0 | -1.60 | | | 121.0 | -1.20 | | |
| 147.0 | -2.00 | | | 131.0 | -1.50 | | |
| 155.0 | -2.40 | | | 141.0 | -1.50 | | |
| 167.0 | -3.30 | | | 152.0 | -1.60 | | |
| 177.0 | -3.80 | | | 157.0 | -1.70 | | |
| 187.0 | -4.60 | | | 163.0 | -2.10 | | |
| 197.0 | -5.70 | | | 173.0 | -3.10 | | |
| 207.0 | -6.80 | | | 184.0 | -4.00 | | |
| 217.0 | -8.20 | | | 193.0 | -4.90 | | |
| 227.0 | -9.70 | | | 201.0 | -6.30 | | |
| 238.0 | -11.00 | | | 210.0 | -7.20 | | |
| 248.0 | -12.00 | | | 219.0 | -7.80 | | |
| 258.0 | -12.40 | | | 228.0 | -8.00 | | |
| 268.0 | -12.70 | | | 233.0 | -8.00 | | |
| 278.0 | -13.30 | | | 238.0 | -8.50 | | |
| 298.0 | -14.10 | | | 243.0 | -8.80 | | |
| 308.0 | -13.80 | | | 248.0 | -9.60 | | |
| 318.0 | -13.70 | | | 253.0 | -11.50 | | |
| 328.0 | -13.60 | | | 267.0 | -13.20 | | |
| 338.0 | -13.80 | | | 274.0 | -14.00 | | |
| 350.0 | -13.80 | | | 288.0 | -14.10 | | |
| | | | | 309.0 | -14.20 | | |

# TABULATION OF
# CANADIAN ENGINEERING SURVEYS
# 1984 SURVEY DATA

CANADIAN ENGINEERING SURVEYS 1984 PROFILE DATA

Notes:

(1) Survey of ITIYOK ISLAND conducted by boat on August 17, 1984.
(2) Profile data presented in the following tables was extracted from bathymetric plot produced by CES (1984) which is included in the material archived with this report.
(3) Distances along each profile line are from the design island centre as defined in the CES bathymetric plot.
(4) Depths, in metres and tenths, are assumed to be relative to mean sea level.

| Distance (m) | Profile Line 000 | 020 | 040 | 060 | 080 | 100 |
|---|---|---|---|---|---|---|
| 150 | | | | | | -6.8 |
| 160 | | | | | | -7.8 |
| 170 | | | | | | -8.6 |
| 180 | -6.3 | -5.8 | -7.2 | | | -9.8 |
| 190 | -8.0 | -7.3 | -8.1 | | -7.4 | -10.6 |
| 200 | -9.0 | -8.6 | -9.1 | -6.0 | -7.7 | -11.3 |
| 210 | -9.9 | -9.5 | -10.0 | -6.6 | -8.1 | -11.9 |
| 220 | -10.3 | -12.2 | -10.9 | -8.0 | -9.6 | -12.2 |
| 230 | -12.0 | -12.6 | -11.7 | -9.9 | -10.2 | -12.4 |
| 240 | -13.0 | -13.1 | -12.4 | -11.4 | -11.0 | -12.8 |
| 250 | -13.2 | -13.7 | -12.6 | -12.1 | -12.1 | -12.8 |
| 260 | -13.5 | -13.8 | -13.0 | -12.2 | -12.6 | -13.0 |
| 270 | -13.9 | -13.8 | -13.4 | -12.8 | -12.9 | -13.4 |
| 280 | -14.0 | -14.1 | -13.7 | -13.3 | -13.2 | -13.4 |
| 290 | -14.2 | -14.2 | -14.0 | -13.7 | -13.6 | -13.3 |
| 300 | -14.2 | -14.2 | -13.9 | -13.8 | -13.7 | -13.4 |
| 310 | -14.1 | -14.2 | -13.6 | -13.9 | -13.6 | -13.4 |
| 320 | -14.8 | -14.2 | -13.9 | -14.0 | -13.9 | -13.4 |
| 330 | -14.2 | -14.3 | -14.1 | -14.3 | -13.7 | -14.0 |
| 340 | -14.4 | -14.3 | -14.3 | -14.1 | -13.8 | -14.0 |
| 350 | -14.4 | -14.4 | -14.4 | -14.0 | -13.9 | -13.8 |
| 360 | -14.4 | -14.5 | -15.0 | -14.1 | -14.0 | -13.7 |
| 370 | -14.3 | -14.3 | -14.4 | -14.0 | -13.9 | -13.8 |
| 380 | -14.6 | -14.5 | -14.4 | -14.1 | -13.8 | -13.7 |
| 390 | -14.5 | -14.6 | -14.5 | -14.3 | -13.8 | -14.0 |
| 400 | -14.3 | -14.7 | -14.6 | -13.7 | -13.8 | |

| Distance (m) | Profile Line 120 | 140 | 160 | 180 | 200 | 220 |
|---|---|---|---|---|---|---|
| 150 | -6.6 | | | | | |
| 160 | -7.5 | | | | | |
| 170 | -8.3 | -7.2 | -9.2 | | | |
| 180 | -9.7 | -8.5 | -11.4 | -9.8 | -8.5 | |
| 190 | -10.4 | -10.6 | -12.7 | -11.9 | -9.3 | -7.6 |
| 200 | -11.0 | -11.4 | -13.0 | -13.1 | -10.3 | -9.1 |
| 210 | -11.6 | -11.9 | -13.1 | -13.8 | -11.5 | -10.3 |
| 220 | -12.1 | -12.0 | -13.2 | -13.9 | -12.5 | -11.6 |
| 230 | -12.3 | -12.3 | -13.8 | -13.8 | -13.0 | -12.7 |
| 240 | -12.5 | -13.0 | -13.9 | -14.0 | -13.6 | -13.2 |
| 250 | -12.6 | -13.1 | -13.9 | -14.0 | -13.8 | -13.3 |
| 260 | -12.7 | -13.2 | -14.0 | -14.1 | -14.1 | -13.6 |
| 270 | -12.9 | -13.4 | -14.0 | -14.2 | -14.2 | -13.7 |
| 280 | -13.3 | -13.6 | -14.5 | -14.8 | -14.5 | -13.8 |
| 290 | -13.5 | -13.7 | -14.0 | -14.8 | -14.3 | -14.0 |
| 300 | -13.7 | -14.4 | -14.0 | -14.5 | -14.6 | -13.0 |
| 310 | -13.5 | -14.0 | -14.4 | -14.8 | -13.9 | -13.8 |
| 320 | -13.6 | -13.9 | -14.7 | -14.8 | -13.6 | -14.4 |
| 330 | -13.8 | -14.1 | -14.3 | -14.4 | -13.9 | -14.4 |
| 340 | -14.0 | -14.3 | -14.5 | -14.4 | -13.8 | -14.6 |
| 350 | -14.0 | -13.9 | -14.6 | -14.5 | -14.2 | -14.3 |
| 360 | -13.9 | -14.0 | -14.1 | -13.8 | -14.2 | -14.1 |
| 370 | -14.2 | -14.1 | -14.1 | -13.7 | -14.3 | -14.1 |
| 380 | -13.9 | -14.1 | -14.3 | -13.9 | -14.3 | -14.2 |
| 390 | -13.9 | -14.0 | | -14.0 | -14.2 | -14.2 |
| 400 | | -13.9 | | -14.1 | -14.2 | -14.2 |

| Distance (m) | Profile Line 240 | 260 | 280 | 300 | 320 | 340 |
|---|---|---|---|---|---|---|
| 150 | | | | | | |
| 160 | | | | | | |
| 170 | | | | | | |
| 180 | | -5.0 | | | | -5.7 |
| 190 | -8.7 | -6.7 | | | -6.5 | -6.6 |
| 200 | -9.7 | -7.9 | | -5.0 | -6.7 | -7.0 |
| 210 | -10.7 | -8.3 | -5.5 | -6.3 | -7.5 | -8.0 |
| 220 | -10.9 | -10.6 | -6.2 | -8.7 | -9.4 | -9.7 |
| 230 | -11.5 | -11.1 | -6.8 | -9.2 | -10.5 | -10.3 |
| 240 | -11.9 | -11.5 | -7.9 | -9.7 | -11.7 | -10.5 |
| 250 | -12.3 | -12.0 | -8.2 | -9.8 | -12.8 | -10.5 |
| 260 | -12.7 | -12.4 | -8.7 | -10.0 | -12.5 | -11.5 |
| 270 | -12.8 | -12.5 | -9.4 | -11.0 | -13.4 | -12.9 |
| 280 | -13.3 | -12.8 | -10.7 | -12.5 | -13.1 | -13.5 |
| 290 | -13.8 | -13.0 | -12.0 | -12.9 | -13.3 | -13.9 |
| 300 | -14.0 | -13.1 | -13.0 | -13.2 | -13.5 | -14.0 |
| 310 | -14.3 | -13.7 | -13.3 | -13.4 | -13.7 | -14.4 |
| 320 | -14.5 | -13.4 | -13.6 | -13.2 | -13.6 | -14.3 |
| 330 | -14.0 | -13.8 | -13.4 | -13.5 | -13.9 | -14.4 |
| 340 | -14.5 | -13.9 | -13.6 | -13.9 | -14.1 | -14.3 |
| 350 | -14.6 | -13.5 | -13.9 | -14.2 | -14.2 | -14.4 |
| 360 | -13.9 | -13.5 | -13.7 | -14.2 | -14.1 | -14.5 |
| 370 | -13.9 | -13.7 | -13.8 | -14.1 | -14.2 | -14.5 |
| 380 | -13.8 | -13.9 | -13.8 | -14.3 | -14.2 | -14.4 |
| 390 | -13.9 | -13.9 | -13.9 | -14.3 | -14.3 | -14.4 |
| 400 | -14.1 | -13.9 | -14.0 | -14.3 | -14.4 | -14.4 |

# DESCRIPTION OF DATA DISKETTES

DATA DISKETTE 1
ITIYOK ISLAND PROFILE LINE DATA

Volume Label is ITIYOK DATA

FILE DESCRIPTION
---

1. READ.ME : Contains a short description of the file contents on the disk.

2. There are 36 files of Dobrocky Seatech Limited survey data labelled DSL000.DAT, DSL010.DAT, DSL020.DAT, ... , DSL350.DAT. Each file contains pairs of distance and elevation data along a single profile line. There are 21 files comprising beach profile and echo sounder survey data and 15 files comprising beach profile data only. All data is in metres. Distances are relative to the temporary survey benchmark which was installed on the central portion of the island. Elevations have been related to mean sea level.

3. There are 18 files of Canadian Engineering Surveys data labelled CES000.DAT, CES020.DAT, CES.040.DAT, ... , CES340.DAT. Each file contains pairs of distance and elevation data along a single profile line. Distance is relative to the design island centre as shown on the CES drawing and elevation is assumed to be relative to mean sea level.

DATA DISKETTE 1
ITIYOK ISLAND PROFILE LINE DATA

Volume Label is ITIYOK DATA

Directory

| File | Ext | Size |
|---|---|---|
| READ | ME | 1108 |
| DSL000 | DAT | 511 |
| DSL010 | DAT | 222 |
| DSL020 | DAT | 477 |
| DSL030 | DAT | 188 |
| DSL040 | DAT | 426 |
| DSL050 | DAT | 171 |
| DSL060 | DAT | 426 |
| DSL070 | DAT | 154 |
| DSL080 | DAT | 528 |
| DSL090 | DAT | 137 |
| DSL100 | DAT | 528 |
| DSL110 | DAT | 137 |
| DSL120 | DAT | 562 |
| DSL130 | DAT | 137 |
| DSL140 | DAT | 460 |
| DSL150 | DAT | 171 |
| DSL160 | DAT | 426 |
| DSL170 | DAT | 188 |
| DSL180 | DAT | 392 |
| DSL190 | DAT | 205 |
| DSL200 | DAT | 681 |
| DSL210 | DAT | 273 |
| DSL220 | DAT | 579 |
| DSL230 | DAT | 273 |
| DSL240 | DAT | 562 |
| DSL250 | DAT | 793 |
| DSL260 | DAT | 847 |
| DSL270 | DAT | 847 |
| DSL280 | DAT | 847 |
| DSL290 | DAT | 847 |
| DSL300 | DAT | 775 |
| DSL310 | DAT | 271 |
| DSL320 | DAT | 649 |
| DSL330 | DAT | 235 |
| DSL340 | DAT | 667 |
| DSL350 | DAT | 271 |

DATA DISKETTE 1
ITIYOK ISLAND PROFILE LINE DATA

Volume Label is ITIYOK DATA

Directory (Continued)

| File | Ext | Size |
|---|---|---|
| CES000 | DAT | 342 |
| CES020 | DAT | 342 |
| CES040 | DAT | 343 |
| CES060 | DAT | 295 |
| CES080 | DAT | 309 |
| CES100 | DAT | 351 |
| CES120 | DAT | 351 |
| CES140 | DAT | 337 |
| CES160 | DAT | 309 |
| CES180 | DAT | 323 |
| CES200 | DAT | 323 |
| CES220 | DAT | 309 |
| CES240 | DAT | 309 |
| CES260 | DAT | 323 |
| CES280 | DAT | 281 |
| CES300 | DAT | 295 |
| CES320 | DAT | 309 |
| CES340 | DAT | 323 |

DATA DISKETTE 2
ITIYOK ISLAND 3-D (X,Y,Z) DATA

Volume Label is ITIYOK_ISLE

Directory

| File | Ext | Size | Date |
|---|---|---|---|
| BEACH | DAT | 13505 | 8-28-86 |
| TOTAL | DAT | 29275 | 8-29-86 |
| READ | ME | 1050 | 5-15-87 |

Description

BEACH.DAT — Contains 422 (x,y,z) triplets of beach data only
Format xxxxx.xxyyyyy.yyzzzzz.zz or 3F8.2
Original [bearing,range,elevation] data have been converted to [x,y,z] data with z-values corrected for tides

TOTAL.DAT — Contains 915 (x,y,z) triplets of beach and echo sounder data (i.e. the total data set)
Format xxxxx.xxyyyyy.yyzzzzz.zz or 3F8.2
Original [bearing,range,elevation/depth] data have been converted to [x,y,z] data with tide corrections applied to z-values

READ .ME — Contains a short description of file contents on disk volume ITIYOK_ISLE